# Contents—Mar. 1938

Volume XIX No. 3

ARCHIVES OF PHYSICAL THERAPY

DISRAELI KOBAK, M.D., Editor

Suite 712 — 30 North Michigan Avenue, Chicago, Illinois

Original contributions, exchanges and books for review should be forwarded to the Editorial Office. All business matters including advertising should be handled through the Executive Office, Suite 712 — 30 N. Michigan Ave., Chicago, Illinois. The statements in the manuscripts published in the ARCHIVES OF PHYSICAL THERAPY, are made solely on the responsibility of the author. The American Congress of Physical Therapy does not assume any responsibility for statements contained therein. Manuscripts accepted for publication in ARCHIVES OF PHYSICAL THERAPY, are for exclusive publication and may not be published elsewhere.

OFFICERS

American Congress of Physical Therapy

FREDERICK L. WAHRER, M.D., Marshalltown, Iowa, President.
FRANK H. KRUSEN, M.D., Rochester, Minn., President-Elect.
WILLIAM H. SCHMIDT, M.D., Philadelphia, First Vice-President.
NATHAN H. POLMER, M.D., New Orleans, Second Vice-President.
FRED B. MOOR, M.D., Los Angeles, Third Vice-President.
KRISTIAN G. HANSSON, M.D., New York, Fourth Vice-President.
MILAND E. KNAPP, M.D., Minneapolis, Fifth Vice-President.
JOHN STANLEY COULTER, M.D., Chicago, Treasurer.
RICHARD KOVÁCS, M.D., New York, Secretary.
MARION G. SMITH, B.S., Chicago, Executive Secretary.
A. R. HOLLENDER, M.D., Chicago, Managing Director.

EXECUTIVE COUNCIL

William Bierman, M.D., New York, *Chairman.*
Norman E. Titus, M.D., New York, *Secretary.*
John Stanley Coulter, M.D., Chicago.
James C. Elsom, M.D., Madison, Wisconsin.
Frank H. Ewerhardt, M.D., St. Louis.
Roy W. Fouts, M.D., Omaha.
John Severy Hibben, M.D., Pasadena.
Disraeli Kobak, M.D., Chicago.
Gustav Kolischer, M.D., Chicago.
Albert Frank Tyler, M.D., Omaha.
Frank H. Walke, M.D., Shreveport, La.
Frederick L. Wahrer, M.D., Marshalltown, Iowa, Ex-Officio.

PUBLICATION COMMITTEE

DISRAELI KOBAK, M.D.
A. R. HOLLENDER, M.D.
ALBERT F. TYLER, M.D.
M. C. L. McGUINNESS, M.D.
RICHARD KOVÁCS, M.D.
WM. H. SCHMIDT, M.D.
FRANK H. KRUSEN, M.D.

Subscriptions — In the United States, its possessions, and Mexico, $5.00 yearly; Canada, $5.50; elsewhere, $6.50 the year.

Advertising rates on application. All advertising copy subject to acceptance by publication committee.

Published monthly at Chicago, Illinois, by American Congress of Physical Therapy.

Entered as Second Class Matter January 29, 1938, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

## ORIGINAL ARTICLES

Effects of Heat, Cold, and Other Stimuli Upon Human Circulation ....Clarence W. Dail, M.D., and Fred B. Moor, M.D. 135
Discussed by Drs. S. E. Bilik, Heinrich Wolf and Fred B. Moor.

Pyretotherapy in Cardio-Vascular Diseases.....Professor Charles Laubry, J. Walser M.D., and Jean Meyer, M.D. 144

Electrosurgery of Cancer of Nasal Accessory Sinuses .....Edwin N. Kime, M.D. 155

Passive Vascular Exercise in Treatment of Peripheral Vascular Diseases.....George H. Yeager, M.D. 158

Physical Therapy in Peripheral Vascular Disease..... .....Irving Sherwood Wright, M.D. 161
Discussed by Drs. John H. Gibbon, Edward A. Edwards, Leopold Brahdy, Williams Collins, N. H. Polmer, Heinrich Wolf and Irving Sherwood Wright.

Diathermy in Subacromial Bursa and Supraspinatus Tendon Calcification.....B. S. Troedsson, M.D. 166
Discussed by Drs. John D. Currence, Nelson Morris, Norman E. Titus and B. S. Troedsson.

## EDITORIALS

Short Wave Diathermy in Cardiovascular Disease..... 173

Intensive Instruction Course to Precede Seventeenth Annual Session ..... 175

## CORRESPONDENCE

Dosage Measurement in Short Wave Diathermy..... 176

## SPECIAL SECTION

Science, News, Comments..... 180

## THE STUDENT'S LIBRARY

Book Reviews ..... 181

## INTERNATIONAL ABSTRACTS

Abstracts from Physical Therapy, X-Ray, Radium, Biophysics ..... 183

## THERE IS ONLY ONE INDUCTOTHERM

It is easy to recognize; its appearance is distinctive; nothing fancy hides its rugged construction. There are no gadgets to complicate its performance. It has strength of character; it sets out to do certain important things and does them consistently well.

It was designed to make electromagnetic induction available for the heating of the deep tissues of the body. This it does. When you buy an Inductotherm, you acquire a superior means of producing heat for medical purposes, for treatment of localized disorders or for the creation of therapeutic fever. There is only one Inductotherm and it bears the G-E monogram.

## THESE ARE THE UNVARNISHED FACTS

The basic principle of the Inductotherm has been proved best for the purpose. The apparatus from electrical and mechanical standpoints is a superior product. You would use it often and with confidence as do the several thousands that already own Inductotherms. Because, in your practice, it would not be idle, it would be profitable; producing satisfactory financial returns as well as gratifying clinical results.

## MAKE THIS CONVINCING TEST

Inspect an Inductotherm, operate it, apply it to yourself. Assure yourself that it *is* well worth considering as an addition to your therapeutic equipment, that it is the sturdy, useful type of apparatus that you would benefit from greatly. Read, sign, clip, and mail the handy coupon — NOW.

## ABSOLUTELY NO OBLIGATION INVOLVED

**GENERAL ELECTRIC**
**X-RAY CORPORATION**
**2012 Jackson Blvd. Chicago, Ill.**

Please arrange with me for a convenient time to demonstrate the value of the G-E Inductotherm.

NAME _____

ADDRESS _____

CITY _____ STATE _____

E13

# EFFECTS OF HEAT, COLD, AND OTHER STIMULI UPON HUMAN CIRCULATION *

CLARENCE W. DAIL, M.D.

and

FRED B. MOOR, M.D.

LOMA LINDA, CALIFORNIA

It is common knowledge that heat applied to the body produces dilatation of the peripheral blood vessels while cold stimuli cause constriction. The substance of this paper, therefore, is not new. We have studied the circulatory responses to heat and cold by means of a plethysmograph placed upon the arm and recorded by a special tambour upon a long paper kymograph. Our reason for presenting such a familiar subject, is that these physiologic considerations are the very foundation of the scientific application of physical therapy.

Consideration of the local effects of heat and cold is not within the scope of this paper, they having been presented by Landis[1], Drury and Jones[2], Goldschmidt and Light[3], and others. We will restrict ourselves to local applications so far as they affect the circulation in general.

Amitin[4], in 1897, presented a plethysmographic study of changes in arm volume produced by local applications of hot and cold water. She paid little attention, however, to the general circulatory response to these stimuli. Hers was a study of local effects, except that she did observe that psychic stimuli caused a change in arm volume.

Stewart[5], in 1911, reported a careful study of the blood flow in the hand in response to reflex hot and cold stimuli applied to the opposite hand. He observed a distinct increase in blood flow in the right hand when the left was placed in warm water and a distinct decrease when the left hand was placed in cold water. Hewlett[6], in 1911, contributed an important study of the effects of heat and cold on the circulation by determining the rate of blood flow. He observed an increase in the opposite arm in response to heat and a decrease in response to cold. General heating procedures caused an increase in blood flow in the arm even when it was not included in the heated area. Briscoe[7], in 1918, during a study of capillary and venous pressures observed that when one hand was placed in cold water, the veins in the opposite hand became less prominent and the capillary pressure decreased within five seconds.

Hauffe[8], in a series of very interesting articles published in 1926, discussed at length the circulatory responses of the body to heat. He observed the same plethysmographic responses that have been already mentioned. He contends, however, that in order to get maximal peripheral dilatation, it is necessary to use slowly increasing degrees of heat rather than sudden high temperatures. He thinks that a dilatation of surface capillaries is no indication of a general dilatation of all of the vessels of the skin and subcutaneous tissues.

Hauffe[9] further believes that, in the circulatory balance between the interior and the periphery of the body, the heart cavity, the pulmonary circulation, and the aorta with its large branches form a reservoir which is in

* This study was aided by a grant from The Mortensen Research Fund.
* From the Department of Pharmacology and Therapeutics, College of Medical Evangelists.
* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 11, 1936.

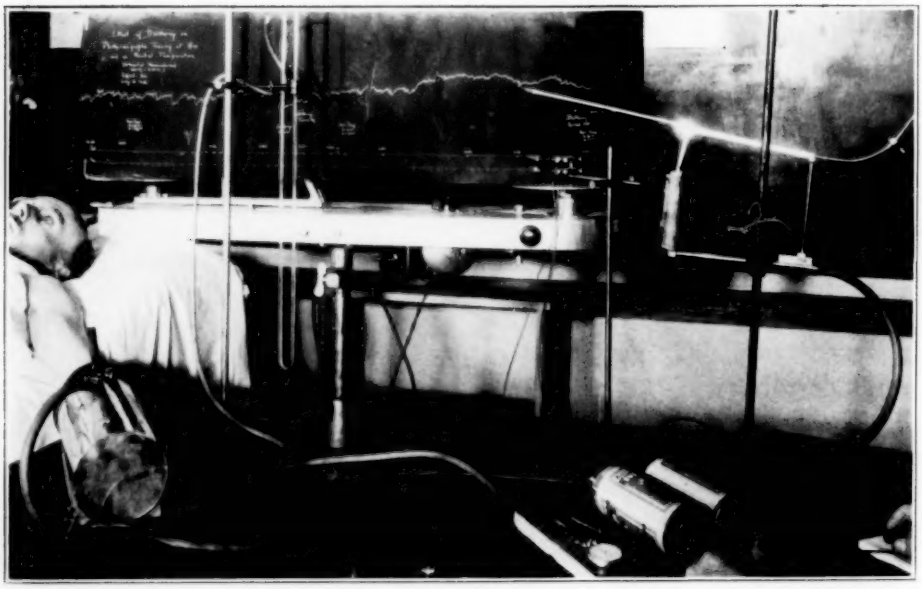

Fig. 1. — Plethysmograph, tambour and long paper kymograph used for recording arm volume.

equilibrium with the periphery and the intrinsic vessels of the organs of the abdomen and chest. The coronary and bronchial vessels and those of the abdominal organs are classed as periphery in their relationship to the reservoir. Therefore, we have the vessels of the skin, the extremities, and the viscera in balance with the reservoir area made up of the heart cavity, pulmonary vessels, aorta and its large branches. Hauffe maintains as evidence of the correctness of his analysis of the circulatory response to heat, that when the periphery is heated the heart decreases in size and the lung fields become clearer under the fluoroscope. This last statement we have checked on six experimental subjects as described below.

## Experimental Methods

The subjects used in this experimental study were all normal medical students ranging in age from 20 to 30 years. The experiments were all done in the middle or late afternoon. The noon meal was allowed except in the case of those experiments in which the stomach tube was used.

In the earlier experiments an ordinary arm plethysmograph with the usual rubber cuff was used. In the later experiments this was altered by substituting a pneumatic cuff in which the pressure could be very accurately controlled. In this way the plethysmograph could be kept at its maximal sensitiveness.

A special tambour was constructed to secure an excursion on the tracing of about 3 cm. for each 10 cc. variation in arm volume. Figure 1 shows a photograph of the apparatus.

Several sources of heat were used in these experiments: (1) A sheet metal canopy about two feet high and containing eight 60 watt tungsten lamps was applied for 30 to 90 minutes over the lower extremities. (2) Hot fomentations were applied to the lower extremities for 30 to 90 minutes. (3) In a few experiments the subjects were placed with the body up to the neck inclosed in the Russian steam bath for 30 to 60 minutes. (4) Diathermy was applied to the abdomen for 30 to 60 minutes. In some of the diathermy experiments, a Beckman thermometer was inserted into the rectum for the accurate determination of the rectal temperature. (5) In several experiments, the subjects were given hot, neutral, and cold water to

drink. In others water at the same temperatures was given through insulated and uninsulated Levine tubes to rule out the influence of thermic stimuli to the throat.

To determine any change in the size of the heart and the density of the lung fields by means of the roentgen ray, each of five subjects was placed upon the x-ray table. A preliminary film was taken of the chest. This was followed by a 45-minute application of the radiant heater canopy to the legs at the end of which a second film was taken of the chest. Next the body surface was chilled by means of ice and ice water to the legs, abdomen, and chest. Immediately after this a third film was taken of the chest. The technic was identical for all of the films on the same individual. No automatic timing device being available, the roentgenograms were taken on the pulse beat to secure as nearly as possible the same phase of the cardiac cycle. In one subject an effort was made to determine changes in the size of the heart and the transparency of the lung fields by means of the fluoroscope.

## Results

In twenty-five experiments in which the radiant heater canopy was used, there was always an increase in arm volume, starting in one to five minutes after the application of the heat to the legs. The response varied considerably with different individuals, with the sensitiveness of the apparatus, and with the room temperature. During the later experiments, the sensitiveness of the apparatus was always satisfactory owing to the use of the pneumatic cuff. It was observed that the application of ice or ice water to any area of the body, such as the epigastrium, the sole of the foot, or the leg, would always cause a decrease in arm volume. The electric fan allowed to blow over the nude body, especially when the subject was perspiring, produced powerful vasoconstriction. In fact the mere suggestion of the application of ice to the epigastrium or the rattling of ice in a pan caused marked vasoconstriction in susceptible individuals. Figure 2, part 1, illustrates some of these effects.

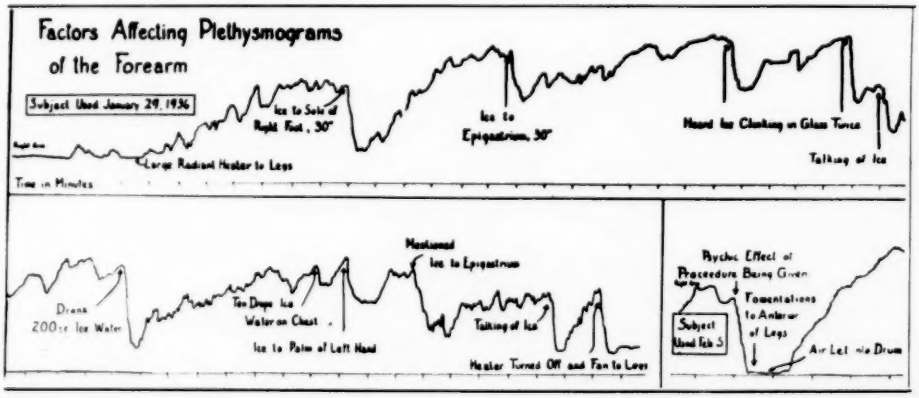
Factors Affecting Plethysmograms of the Forearm
Subject Used January 29, 1936
Ice to Sole of Right Foot, 30"
Ice to Epigastrium, 30"
Heard Ice Clinking in Glass Tumbler
Talking of Ice
Large Radiant Heater to Legs
Time in Minutes
Drank 200cc Ice Water
Ice to Palm of Left Hand
Heater Turned Off and Fan to Legs
Psychic Effect of Procedure Being Given
Fomentations to Anterior of Legs
Air Let into Drum

Fig. 2. — Part 1. — Increase in arm volume produced by the large radiant heater to the legs and sudden decreases caused by cold cutaneous stimuli and by psychic influences.

In twenty experiments, in which fomentations were used to the lower extremities, the results varied slightly from those obtained with radiant heat. The increase in arm volume, which was constant in all of these experiments, was preceded in some by slight decrease in volume lasting a minute or two. The rate of increase in the arm volume with radiant heat and with fomentations was practically the same. Here again was observed the immediate vasoconstriction produced by chilling a large part of the body surface with the electric fan or by chilling a small area with a piece

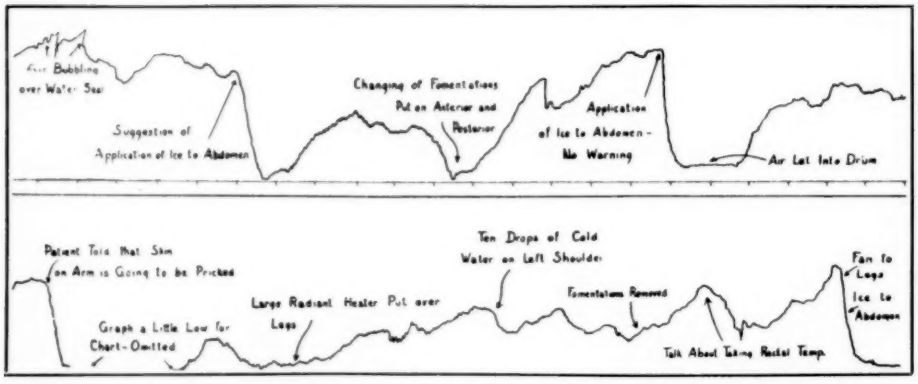
Bubbling over Water Seal
Suggestion of Application of Ice to Abdomen
Changing of Fomentations Put on Anterior and Posterior
Application of Ice to Abdomen - No Warning
Air Let Into Drum
Patient Told that Skin on Arm is Going to be Pricked
Graph a Little Low for Chart - Omitted
Large Radiant Heater Put over Legs
Ten Drops of Cold Water on Left Shoulder
Fomentations Removed
Talk About Taking Rectal Temp.
Fan to Legs
Ice to Abdomen

Fig. 2. — Part 2. — Increase in arm volume produced by fomentations to the legs and sudden decreases caused by cold cutaneous stimuli and psychic influences.

of ice. In these subjects also the power of suggestion was important, as shown by prompt vasoconstriction in many of them upon the mere mention of the application of ice to the body surface. These effects are illustrated in figure 2, part 2.

In five diathermy experiments the increase in arm volume was more gradual but none the less definite. The increase in arm volume ran parallel to a slight increase in rectal temperature as shown by the Beckman thermometer. The subjects were found to respond to the same cold stimuli in the same manner as did those who received radiant heat and fomentations. These effects are illustrated in figure 3.

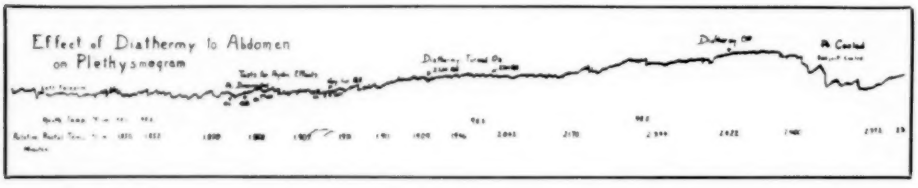


Fig. 3. — Gradual increase in arm volume produced by diathermy to the abdomen with increased mouth and rectal temperatures.

The results of three steam baths were not so striking although in the same direction as with other types of heat. The experimental conditions were not entirely satisfactory due to the location of the steam room. The indications are, however, that the results are essentially the same as in the other experiments.

The responses to the drinking of water at various temperatures proved very interesting. Eight experiments were done in the observation of these responses. The mere act of swallowing produced an increase in arm volume. Swallowing of water at 36 to 37.5 degrees C. produced a slight decrease in arm volume. Drinking of water at temperatures of 42 to 55 degrees C. resulted in a definite decrease in arm volume. Ingestion of water at 9 to 12 degrees C. brought about the most marked decrease of all.

When water was given by an ordinary Levine tube directly into the stomach, the hot and cold water still produced a definite decrease in arm volume, while water at body temperature produced no effect. Water at body temperature administered through a Levine tube, which had been insulated from outside the mouth well down into the esophagus, still produced no effects, while hot and cold water caused definite peripheral vasoconstriction. (Figs. 4, 5 and 6.)

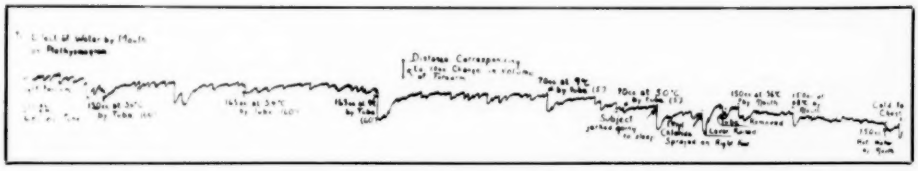

Fig. 4. — Changes in arm volume produced by drinking water at various indicated temperatures in a subject warmed by a large radiant heater applied to the legs.

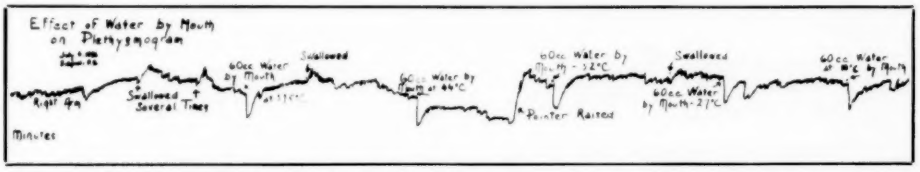


Fig. 5. — Changes in arm volume produced by introducing water at various indicated temperatures through a Levine tube into the stomach in a subject warmed by a large radiant heater applied to the legs.

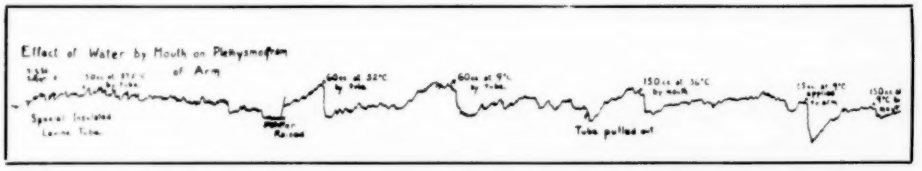


Fig. 6. — Changes in arm volume produced by introducing water at various indicated temperatures through an insulated Levine tube into the stomach in a subject warmed by a large radiant heater applied to the legs.

In the observation of five subjects with the roentgen ray to determine density of the lung fields and changes in the size of heart in response to heat and cold, the results were suggestive but not convincing. The following are the results of the reading of the films by a well trained roentgenologist. (Table 1.)

TABLE 1. — *Effects of Heat, Cold, and Other Stimuli Upon the Human Circulation*

| Subj. | Diam. Chest cm. | Normal Right Trans. Diam. cm. | Normal Left Trans. Diam. cm. | Normal Greatest Density Lung | After 45 Min. Heat Right Trans. Diam. cm. | After 45 Min. Heat Left Trans. Diam. cm. | After 45 Min. Heat Greatest Density Lung | After Gold Right Trans. Diam. cm. | After Gold Left Trans. Diam. cm. | After Gold Greatest Density Lung |
|---|---|---|---|---|---|---|---|---|---|---|
| A | 34.5 | 5.5 | 8.9 | X | 5.5 | 8.3 | .... | 5.8 | 8.1 | .... |
| B | 33.0 | 5.0 | 9.55 | X | 5.0 | 8.9 | .... | 4.55 | 9.3 | .... |
| C | 35.0 | 5.2 | 11.7 | .... | 5.2 | 10.5 | .... | 5.3 | 11.7 | X |
| D | 33.0 | 6.8 | 7.8 | X | 6.9 | 8.15 | .... | 6.9 | 8.2 | .... |
| E | 29.8 | 5.7 | 10.6 | X | 5.7 | 10.1 | .... | 5.65 | 10.6 | .... |
| Averages | | 5.64 | 9.71 | | 5.66 | 9.19 | | 5.64 | 9.58 | |
| Av. Total Diam. | | 15.35 cm. | | | 14.85 cm. —3.3% | | | 15.22 cm. —0.8% | | |

In one subject observed under the fluoroscope, it seemed that the heart became smaller and the lung fields less dense in response to heat, but these observations could not be accurately measured.

## Discussion

We realize that the possibility of experimental error with the plethysmograph is large. Our medical students were cooperative and quiet, thus helping to minimize one large source of error with this instrument. Carefully adjusted cuffs, with the lowest possible pressure on the arm, lessened the possibility of error by edema. The results were so consistent in a series of sixty experiments that we feel they are reliable.

The response of the body to the application of heat is bound up with the control of body temperature. Heat loss must equal heat production or the body temperature will rise. The heat, lost by the ingestion of cold fluids, by the warming of respired air, and by the loss of water and carbon dioxide from the lungs amounts to 20 per cent of the total loss. The other 80 per cent of heat is lost through the skin by radiation, convection, and by evaporation of water from the skin surface. Under ordinary conditions about two or three times as much heat is lost by radiation and convection as by the evaporation of water. However, an enormous amount of heat may be lost by evaporation in dry, hot atmospheres. For the proper functioning of this elimination of heat through the skin, both for radiation and convection, for the secretion of perspiration, for evaporation and cooling, dilatation of the skin vessels is essential. This, therefore, accounts for peripheral vascular dilatation in response to any measure which tends to raise the body temperature above the normal level. Bazett[10] said: "The effects produced by a general increase of body temperature appear to be similar, whether hot air, hot baths, diathermy or the condenser discharges of the short wave radiotherm are used."

The exact mechanism concerned in the production of this peripheral vasodilatation is, according to Pickering[11], the stimulation of the central mechanism by warmed blood from the periphery. Martin[12] maintains that this is not the only mechanism concerned in the response to external heat; he believes that there is a reflex activity which takes place before the thermal response of the heat center can occur. The functioning of the central heat regulating mechanism is undoubtedly a result of these two factors, since this makes for efficient heat control.

Response of the circulation to cold stimuli is, according to Pickering, at first reflex, but with prolonged applications the heat center is stimulated by the cooled blood and vasoconstriction results. In our experimental work the response to cold stimuli was almost instantaneous, regardless of the point of application to the skin. Only a reflex mechanism could give such a rapid response. Extremes of heat may give a similar response, but much shorter in duration than that to cold. This was observed when extremely hot fomentations were applied to the legs.

In the drinking of water at very high or very low temperatures vasoconstriction results. On first thought one would assume that the thermal stimulation of the mouth and throat by these extremes of temperature had caused these responses reflexly. If, however, this factor be eliminated by introducing an insulated stomach tube, the same vasoconstriction occurs even though the stomach is supposed to have no thermal sensation. The swallowing of water at 36 to 37.5 degrees C. also in some subjects produces a decrease in arm volume but the introduction of water at the same temperature through the insulated tube produces no effect. The results obtained by Pickering were similar. If a large quantity of hot water is introduced into the stomach, for instance 500 to 800 cc., after the primary decrease in arm volume, there is an increase due to the actual calories added to the body. This was also observed by Pickering. These responses to the introduction of water at various temperatures into the stomach need further study. They are of some practical importance in therapeutics.

We found one of the most interesting features of our study the effects of psychic stimuli. These effects varied markedly with individual subjects, depending apparently upon the ability to imagine in advance the sensation which might be produced by the suggested stimulus, such as the application of ice, or the prick of a pin. It shows us how closely the autonomic is linked with the voluntary nervous system. In some subjects the anticipa-

tion of the application of ice to the epigastrium produced a more marked vasoconstriction than the actual application. These psychic responses were always in the direction of constriction.

The changes in the size of the heart and the density of the lung fields in response to heat and cold as suggested by Hauffe[8] require more study. Although our findings are suggestive, the number of subjects is too small to draw any definite conclusions. An accurate timing device for taking the roentgenograms of the heart would be essential before one could be certain of such small changes in the cardiac diameter. It is hoped that these effects may be studied further with a more exact technic.

## Summary

1. Applications of heat in the form of radiant heat, fomentations, diathermy, or steam baths give rise to peripheral vascular dilatation as shown by the plethysmogram of the arm.

2. Applications of cold water or ice to any part of the body cause peripheral constriction as shown by a decrease in arm volume.

3. Psychic stimuli, such as the anticipation of the application of ice or the prick of a pin, are potent means of producing peripheral constriction.

4. The drinking of hot or cold water, and in some subjects, even neutral water causes peripheral constriction. If hot or cold water is introduced into the stomach through an insulated tube, a reduction in arm volume results, but neutral water given in this way does not have this effect.

5. It is indicated but not absolutely proved that heat to the body surface causes a decrease in the size of the heart and the density of the lung fields. Cold stimuli to the body surface on the other hand cause the opposite effects.

## References

1. Landis, E. M.: Micro-injection Studies of Capillary Blood Pressure in Human Skin, Heart **15**:209 (May) 1930.

2. Drury, A. N., and Jones, N. W.: Observations Upon Rate at Which Edema Forms When Veins of the Human Skin Are Congested, Heart **14**:55 (April) 1927.

3. Goldschmidt, Samuel, and Light, Arthur B.: The Effect of Local Temperature Upon Peripheral Circulation and Metabolism of Tissues as Revealed by Gaseous Content of Venous Blood, A. J. Physiol. **73**:146, 1925.

4. Amitin, Sarah: The Effect of Heat and Cold on the Tone of Blood Vessels, Ztschr. f. Biol. **17**:13, 1897.

5. Stewart, G. N.: Studies on Circulation in Man. Heart **3**:33, 88, 1911.

6. Hewlett, A. W.: van Zwaluwenburg, J. G., and Marshall, Mark: Effects of Some Hydrotherapeutic Procedures on Blood-flow in the Arm, Arch. Int. Med. **8**: 591, 1911.

7. Briscoe, Grace: Observations on Venous and Capillary Pressures, with Special Reference to "Raynaud Phenomenon," Heart **7**:35, 1918.

8. Hauffe, George: Physical Therapy of Practicing Physician, Med. Klin. **21**: 1811, 1925.

9. ————: Physical Therapy of Practicing Physician, Med. Klin. **22**:26, 1926.

10. Bazett, Henry C.: Temperature Changes and Their Effects on Circulation, Northwest. Med. **32**:173 (May) 1933.

11. Pickering, G. W.: Vasomotor Regulation of Heat Loss from Human Skin in Relation to External Temperature, Heart **16**:115 (July) 1932.

12. Martin, Sir Chas. J.: Thermal Adjustment of Man and Animals to External Conditions (Croonian Lecture), Lancet **2**:561 (Sept. 13) 1930; 617 (Sept. 20) 1930; 673 (Sept. 27) 1930.

## Discussions

**Dr. S. E. Bilik** (New York): The essayists have attempted to establish a scientific basis for the generally accepted principle that when the heat content of the body rises above normal our heat regulating mechanism responds by a relative increase in the peripheral circulation in an effort to get rid of this excess heat. I did not know that this physiologic concept had not been substantiated experimentally. Irritability is one of the fundamental, basic properties of protoplasm. Its aim is

protection. When extremes of temperature, heat or cold, are applied to the skin with sufficient intensity to alarm the sensory nerve ends, the instantaneous response is reflex and in an attempt to escape from the irritant, constriction follows. The reported initial constriction of the blood vessels is probably incidental to the general constriction of all the soft tissues of the arm.

Following this instinctive reaction the heat center probes the nature of the attack and solves it more intelligently. When the investigators supplied heat by means of the hood type baker, the rise in temperature was gradual. No initial constriction followed. It was not to be expected that one would follow. The increase in peripheral dilatation was progressive. Dr. Kellogg, of Battle Creek, I recall, made exactly the same statement 25 years ago, stressing the importance of giving heat treatment progressively. With diathermy, if the milliamperage is increased gradually and is kept moderate, there is no initial constriction. If advanced rapidly or kept high, there is definite constriction as established by S. Benson of Chicago. The application of hot fomentation was sudden. They, therefore, acted as a definite irritant and, consequently, Dr. Moor and Dr. Dail obtained an initial constriction. Following that we had a normal response to heat which meant a progressive dilatation of the peripheral circulation.

I want to ask Dr. Moor how he applied fomentations from 30 to 90 minutes. If the packs were changed suddenly one would except repeated periods of constriction if the heat was of sufficient intensity. I quote one of Dr. Moor's summaries: "Application of cold stimuli to any part of the body causes peripheral constriction. As pointed out, the initial constriction is probably a reflex one. It should be followed by a constriction regulated by our heat regulating mechanism."

How long does this permanent constriction last when cold is applied locally? Are we to infer that when an ice bag is applied to the hip there is a peripheral vascular constriction throughout the duration of the application, which may mean hours in some cases, or does the body adjust itself and the constriction is purely local? Finally, I would like to ask the investigators two questions: Why does the drinking of cold, or iced water following vigorous exercise, particularly in athletes, produce an immediate sensation of nausea?

Secondly, when I immerse my hand in a tub of hot water blood rushes to the arm through a main channel leading to it. Theoretically, under the continued stimulus these blood vessels soon dilate to their absolute maximum under the pressure of the ingressing blood. In what way can diathermy, short-wave diathermy, or paraffin baths, improve on this simple, old-fashioned method of producing a localized hyperemia?

**Dr. Heinrich Wolf** (New York): To substantiate the theory of Simon Baruch as to the importance of vascular reactions, I have made some experiments which have thrown a striking light on some of its features. I have not the slightest objection to the results obtained by Dr. Moor. They are very expressive. It seems to me that he, as well as Hauffe, and others who have been working in this line have sufficiently observed and realized the importance of vessels in the circulation of the skin.

I made plethysmographic studies on myself. I put my arm in lukewarm, hot and ice water, watched the curve and then I inhaled amyl nitrite, which, as you know, relaxes the circulation temporarily. I have seen most interesting facts. If the arm was in lukewarm water one could see an increase in dilatation. If it was in ice water, the dilatation disappeared completely during nitrite inhalation and the plethysmograph sank. If, on the other hand, I put it in hot water the dilatation became very large and the curve arose considerably. What does that mean? When I depressed or paralyzed, so to speak, the vessels, the condition of the skin in the periphery determined the amount of blood that would come in. If there was ice water the skin vessels have contracted as in "goose flesh," and no blood could rush in. The dilatation disappeared and the blood rushed into other parts of the body. If, on the other hand, the skin vessels and the skin muscles were very much relaxed, the blood rushed into that low spot with the least resistance. I believe the importance of these skin vessels cannot be sufficiently stressed. What Dr. Moor, Dr. Hauffe and others have shown you is very interesting, that it does not depend on whether the water is hot or whether the temperature is up or down, it depends on the stimulating effect. Hot water has just the same effect as cold water. I do not think it has been sufficiently stressed that it depends on the duration.

If you go into a very hot bath the tunica vaginalis in the scrotum contracts and the scrotum becomes considerably smaller. But, in hot water this contraction lasts only a half minute, while in cold water it persists. The importance of skin vessels may be of very much value in our examination, in our determination of our therapeutic procedures. I believe if we would determine and take into account the action of the skin vessels, we would probably be able to ascertain the value of certain medication, or certain operation beforehand, because the part that the skin muscles play in the circulation of skin has not been established in the literature. My work was done about 20 years ago and it has been published in a periodical which shortly after ceased publication. It may be that on that account it has escaped the attention of the experimenters.

**Dr. Samuel A. Warshaw** (Brooklyn, N. Y.): You will recall that the skin contains unstriated muscle between the papillae and among the fibrous tissue. That between the papillae there is a layer of capillaries, and these capillaries are affected by the action of heat and cold,

on the unstriated muscle between the papillae. Now, therein is the entire story with reference to the action of heat and cold. When cold is applied to the skin we have a contraction of these unstriated muscles. This, in turn, squeezes the capillaries into the meshwork in the papillae and throws the circulation of the capillaries directly into the larger veins and into the circulation. In that way it also forces lymph through the lymphatics.

On the other hand, when you apply heat in any form, whether it is moist heat or hot water, or radiant heat in the form of hot air, the same effect takes place upon the skin. The musculature, the unstriated muscle will relax. That is very definitely shown, as Dr. Wolf explained, on the scrotum, which is the most sensitive part of the human skin. It is more evident when you look for it. Should you at any time apply cold you will note a marked contraction of the skin of the scrotum which will remain, and if you apply heat you will note it will become relaxed. On the other hand, this particular story of the action of heat and cold on the skin gives us a sort of idea just what takes place when we take hot and cold baths. I have often wondered why athletes are advised when they are thoroughly warmed up to immediately jump under a cold shower. When any athlete does that, there is a marked contraction of the entire skin surface, throwing the entire blood of the skin, about 30% of the entire blood directly into the circulation. Naturally, there is an increased amount of blood thrown back upon the heart. If he should have any weak spot there, there may be some damage done.

I would like Dr. Moor to explain if there is any severe danger in taking these cold water baths, or sudden cold baths mornings as some people do. I also want him to explain if the sudden throwing back of the blood directly to the heart would cause any damage there.

Another question arises when patients are exposed to extreme heat, as they are in the institution that I am associated with, is there any advantage of using cold packs to the head? Some authors find that there is no advantage, while others claim that there is. We know that in Turkish and Russian baths they are exposed to very high temperatures. In some particular instances they go up as high as 180 and in some instances up to 200 degrees F. Could Dr. Moor explain if there is any advantage in using any cold applications to the head?

**Dr. Fred B. Moor** (closing): In regard to the change of fomentations or hot packs during these experiments, the packs were not changed. The first pack was put on and when it started to cool slightly, other packs were piled on top so that there was no sudden change in contact with the skin and the heat was kept up for long periods in that way, so that they did not produce the sudden stimulation of the first pack.

How long does constriction of the peripheral vessels last following cold applications? In our observation it is not very long-lived if the cold is removed. It lasts probably four or five minutes. That is probably better answered, however, by the extraordinary work of Landis who observed, as you remember, capillary pressures by means of very fine cannulae, which were introduced into the capillaries at the base of the nails. He observed that in response to these cold applications this constriction which is produced in the capillary by the cold lasted from five to eight minutes and then the constriction gave way to a subsequent dilatation so that the capillary following this was larger than it was before the application.

Dr. Bilik has asked a question on the relief of nausea in athletes by drinking cold water. I have never seen nor known that it was done, but my impression would be that that is most likely a local effect upon the stomach, the action of the cold water upon the stomach itself. However, that is only a guess. He raises the question why we should use diathermy, paraffin baths and various other types of heat to the extremities when we have such simple things as hot water, radiant heat, and the like. I think the question is very pertinent, that is as far as heat to the extremities is concerned. We certainly can heat the extremities to a considerable depth by the simpler methods of the application of heat. We all know that diathermy is a penetrating type of heat. Perhaps in the larger portions of the extremities, such as the knees and thighs, diathermy will produce, especially upon the cuff application, deeper penetration than other types of heat. But, when we come to the trunk, diathermy has certain advantages over conductive types of heat on account of its deep penetration. I have had no experience with paraffin baths, but, of course, a paraffin bath is a conductive type of heat just like hot water.

I am glad Dr. Wolf brought out the point that the effect of these stimuli, the ultimate effect, depends largely on the duration of the stimulus. The body has a tendency to respond by an ultimate peripheral dilatation upon the prolonged application of cold stimuli. That is, if you leave an ice bag on for 20 minutes, you will find the skin surface underneath usually quite red. That is a secondary dilatation. I do not know if the general peripheral constriction produced by the cold stimulus, the primary constriction, still exists at the end of a long period like that or not.

It is certainly true that chilling of the body surface has a great deal to do with the production of respiratory infections. Probably along with the constriction of the skin vessels we also have constriction of the vessels of the mucous membranes of the nose and throat, in fact, I believe that this has been shown to lower the resistance of these membranes to organ-

(*Concluded on page 154*)

# PYRETOTHERAPY IN CARDIO-VASCULAR DISEASES *

PROFESSOR CHARLES LAUBRY
Attending Physician, Hospitals of Paris, France

J. WALSER, M.D.
and
JEAN MEYER, M.D.
PARIS

On first thought it would seem logical to study pyretotherapy in relation to this problem in two distinct parts — general pyretotherapy with elevation of the central temperature, and local pyretotherapy which tends to heat some selected part of the body. We are impressed, however, to note a parallelism of both methods, and wish to submit a report of the common reactions of the circulatory apparatus under the influence of strong excitations apparently different in nature.

Our study excludes peripheral arteritis which will be treated in a further report. We present in this contribution the reactions of the healthy heart with regard to fever and the local energetic supply; the experimental researches, the reactions of the failing heart; angina pectoris; and arterial hypertension.

## Circulatory Apparatus of Healthy Individuals

We present in parallel the circulatory modifications brought about by fever of infectious diseases, by electric fever and by the localized irradiations of the d'Arsonval method of treatment.

*Fever of Infectious Diseases.* — It is almost superfluous to recall the cardiovascular signs: progressively increasing tachycardia starting, on an average, with 72 beats per minute and rising to 80 for a temperature of 38 degrees C., to 90 for a temperature of 39 degrees C., without exceeding 120 in the adult, except in cases of pathologic involvement of the circulatory apparatus. The volume of the pulse becomes smaller. The systolic tension falls, and the higher the pressure, the greater the fall. In fact, the drop which is generally of 1 or 2 cm. of mercury when the temperature is in the neighborhood of 40 degrees C., may reach as much as 5 or 6 cm. of Hg. with patients suffering from high blood pressure. The difference between the systolic and the diastolic pressure almost subsides. The fever itself, regardless of its cause, produces a general depression of the circulatory system.

*Electropyrexia.* — The variations are of the same order as in pathologic fever, except for a few differences. At the same time as the temperature rises, the circulation becomes more active, the pulse rate is accelerated, the respiration more rapid. There is no parallelism between these different factors, or at least they may present sufficient individual disparity to make it impossible, for instance, to evaluate the temperature by the rapidity of the pulse. For a temperature of 39 degrees C., the pulse rate will be around 120; for a temperature of 40 degrees, around 140. It may exceed 200 beats per minute. If the temperature and the pulse rate are recorded on the same sheet, it seems that the curve of the pulse rate rises more rapidly than that of the temperature. Inversely, tachycardia follows less quickly than fever; eventually, it will continue to increase when the temperature has already begun to fall. A sudden increase in the pulsation indicates cardiac failure. Schwarzschild emphasized the necessity of closely watch-

* Read at the First International Conference on Fever Therapy, New York City, March 29, 1937.

ing this rapidity of the pulse, and devised an electrical registering apparatus constantly registering the curve.

Observations referring to the blood pressure do not all agree. All authors acknowledge a drop of the diastolic pressure when the temperature reaches 39 degrees. The reduction amounts to 5 or 6 cm. according to Jones, or to 3 or 4 cm. according to Osborne and Markson. These figures seem to be very much exaggerated.

As regards the systolic pressure, observations differ. Ferguson had already reported a decrease of the blood pressure in radio operators. According to Jones, during the course of electropyrexia, the systolic pressure first rises, and then falls. According to Osborne and Markson, it is increased. Halphen and Auclair consider that the variations in the blood pressure may diverge according to the intervention of the causative factors — vasodilatation, tachycardia, or diminution of the blood volume due to perspiration. In individuals with a normal blood pressure, it falls in 79 per cent of the cases; in 61 per cent of the cases the fall is less than 3 cm., in 18 per cent 3 cm. or more. The fall is more accentuated with patients presenting hypertension; while a slight rise is observed in patients with hypotension. On the other hand, Cignolini states that the blood pressure always falls even when it was already lower than normal before the electropyrexia. The venous pressure, measured by means of a phlebo-piezometer, is always high — from 4 to 10 cm. of water, which indicates the importance of the hyperemia. The retinal tension falls while the ocular tension rises slightly.

In short, in spite of a few important individual variations, there are some differences between the effects of infectious fever and those of electropyrexia.

| | Septic Fever | Electropyrexia |
|---|---|---|
| Pulse: | On a parallel with the temperature. | Quicker, rises rapidly, slower diminution in the rate. |
| Blood Pressure: | Slight fall of the systolic pressure and attenuation of the difference between systolic and diastolic pressure. | Fall of the diastolic pressure. Individual variations in the systole As a rule, no decrease in systole-diastole. |

Finally, after taking a series of radio-kymograms of the heart, Cignolini found an increase in the myocardial contractility and tonicity.

*Local Applications of Electrical Energy.* — In healthy individuals, local applications only determine local circulatory modifications — hyperemia of the part exposed to the electromagnetic action. General variations may occur when the applications concern some sympathetic center, such as the mediastinum, solar plexus or the bulb. A fall of the systolic pressure is noted — about ½ to 1 degree after a session of 10 to 20 minutes giving a very definite impression of heat. We have never observed any modification in the pulse rate or in the diastolic pressure.

As a rule, in a well balanced individual, local d'Arsonvalization of moderate intensity does not modify the blood circulation.

However, following transcardial irradiations of moderate intensity, of 15-30 minutes duration, Cignolini has observed bradycardia, diminution of the pulse volume, and of the myocardial contractility and tonicity, as evidenced by the radio-kymogram; that is to say, the reverse of the conditions determined by general pyrogenic irradiations.

This author made a study of the blood capillaries by means of an electrode perforated so as to allow the insertion of the tube of a dermatologic microscope. Contrary to what he had expected, he observed that active vasodilatation with increased rapidity of the blood stream is only of short duration. After a few minutes it is replaced by vasoconstriction, with slowing of the stream, and

eventually the capillaries become invisible in the object-glass field. We deem it premature to express any opinion.

## Experimental Evidence

Attempts have been made with a view of determining, through experiments on animals, the exact mechanism whereby the short waves have an effect on the circulatory system. We shall relate three different types of experiments: those made on an isolated heart, on capillaries, and those with generalized irradiations.

*Experiments on an Isolated Heart.* — Liebesny and Holzer irradiated a frog and took an electrocardiogram. They noted a slackening of the beats, of about ten per cent, which disappears if one uses Stannius' ligature. They admit a sinusal bradycardia due to the elective action of the short waves on the sympathetic system.

Martini and Viale irradiated the isolated heart with 3.80-meter. The rhythm became accelerated, then the heart-beat was slower and ended with a diastole. The same phenomenon was observed when the temperature of the perfused liquid was too high. This may be attributed to heat.

Agnoli and Vallebona have demonstrated that the short waves reduce the heart volume. There is an opposition between the low intensities which diminish the frequency of the beats, and the high intensities which accelerate it. The shorter waves are the more active.

As a whole, these experiments confirm those made by Fournier and Deglaude on the isolated hearts of rabbits. The heart, perfused following Pachon's technic, is placed between two electrodes laid out as a condenser and separated by a space of from 26 to 84 millimeters. The generator, provided with a regulator, emits waves of 3 to 20 meters.

With 16 to 20-meter waves, which have proved definitely active in therapeutics, we have obtained no variation of the volume of the heart contractions, or supply, or of the frequency of the beats. With 3-meter waves, on the contrary, the action is very definite. The beats are accelerated (from 15 to 30 per cent) and, in cases of pre-existing sinusal arrhythmia, the rhythm becomes regular. The suppression of the condenser field energy provokes the recurrence of the arrhythmia, which again disappears on its re-establishment.

The volume of the beats is increased by 15 to 50 per cent. This augmentation is observed 4 to 56 seconds after starting the apparatus, and reaches its maximum 30 to 90 seconds later, then progressively falls back to normal.

The coronary supply is diminished 15 to 35 per cent in about 30 seconds, then goes up again after the suppression of the field influence. In one single case it was increased. In a few others it remained unchanged. Therefore, vasoconstriction of the coronary seems to be the rule.

Other experiments were made by Leroy on the comparative receptivity of the His-bundle region and of the cardiac muscle in the calf, as measured by the thermocouple. The muscle is more heated with 15-meter waves, and the His-bundle region with 9-meter waves.

While reserving opinions until the advent of more precise research, we may conclude from these experiments that the short waves have a direct action on the heart which absorbs the electromagnetic energy. Very likely, this is not a question of some undetermined electrical effect, but of a functional modification due to a supply of energy divided between the heart muscle proper and its intracardiac conductor system, varying with the length of the waves.

*Action on the Capillaries.* — Contradictory experiments made with irradiation of the capillaries allow us to deduct similar reactions on their part. The first experiments were made by Pflomm. When the legs of a frog are in the electromagnetic field of short waves disposed as a condenser, a vasoconstriction is immediately observed in the capillaries of the interdigital membrane. After

a few seconds, this is replaced by vasodilatation which may assume such an intensity that the blood flows back from the capillaries into the afferent venous system. This phenomenon is independent of the thermic elevation itself and is observed even when the local temperature does not exceed 26 degrees C. It is permanent and persists, though gradually decreasing in 3 to 14 days.

According to Pflomm, these reactions are not due to the heating, but to the intervention of the sympathetic nervous system. As a matter of fact, other functional modifications are also seen as of evident nervous origin — cessation of the vasoconstriction due to faradic current and adrenalin when the capillaries are dilated by the electromagnetic influence.

In a very remarkable study, Cignolini stated precisely the action of short waves, and his conclusions are entirely different from those of Pflomm. His experiments were made on the interdigital membranes, mesentery and tongue. He published some excellent microphotographs. "It is all a question of dosage," says he, "that is to say, of energy supply and heat."

With a low intensity, the capillaries are dilated, the blood flows more rapidly. The vasodilator effect does not prevent the persistence of the vasoconstriction due to adrenalin. A moderate energy provokes permanent vasoconstriction with ischemia. If the energy is very strong, after temporary vasoconstriction, vasodilatation takes place accompanied by stasis and almost complete interruption of the blood stream. The caliber of the capillaries may be increased 5 or 6 times their normal volume. Under such conditions the adrenalin has no effect.

It is the author's impression that the heat is the most important factor of these phenomena, although he has not been able definitely to ascertain the elevation of the local temperature.

*Systemic Electropyrexia and Blood Pressure.* — Laubry and his collaborators submitted rabbits to general irradiations, using Leroy's apparatus, and 6 to 15-meter waves. With 6-meter waves, and an energy emission of 50 to 100 watts, the temperature of the rabbit rose from 1 to 2 degrees in 20 minutes. With a small energy, the blood pressure fell by 3-5 cm. of Hg, rising again immediately after interruption of the current. With a higher intensity the fall was of 1½ cm. in a few minutes, but this fall was followed by a slight secondary rise. In one case, the temperature rose with abnormal rapidity, 3.2 degrees in 10 minutes, and the blood pressure rose from 4.4 cm. to 11.8 cm. Hg in 7 minutes.

With 15-meter the temperature rose more rapidly than with 6-meter waves, if the energy was strong. But it remained about the same when the energy was low.

With a small energy of about 50 watts, the fall of the pressure was more pronounced, 1 cm. of Hg in 9 minutes, for instance, but it rose again partially and remained at the level thus attained.

With 100-watt energy, the blood pressure rose suddenly, passing the initial degree (up to 4.5 Hg). With a very strong intensity, both temperature and pressure rose still higher.

With the human, the therapeutic reactions need only be moderate, and comparable to those provoked in the rabbit by a very low intensity, with elevation of 1 or 2 degrees in 20 minutes and fall of the pressure.

Experiments reveal the dangers of hypertension, which follow the release of too intense an energy emission.

## Cardiopathies

Cardiac lesions — except angina pectoris, which will be considered later — constitute one of the main contraindications to artificial fever. The most dreaded accident is cardiac failure. As a matter of fact, this is not due solely to pre-

existing cardiac changes. An important part is played by the circulatory modifications occurring in the course of electropyrexia or malariatherapy.

The concerned factors are: excessively high and prolonged blood pressure, excessive dehydration due to perspiration, excessive chloride deficiency. In any case, the premonitory signs are: (1) sudden increase in the tachycardia, from 120 to 140 or 160, and even 200, (2) tachypnea, and (3) collapse of the blood pressure.

These accidents seem to be more frequent in cases of pre-existing cardiac insufficiency (gallop rhythm, alternating pulse, functional mitral murmur), or some important cardiopathy, even when well compensated. To be sure, the pyretotherapists give a few precise details of the cardiac signs and functional value of the heart. We shall be satisfied with reproducing below the indications furnished by one of us (Jean Meyer) in collaboration with Paul Chevallier, in 1929, regarding malariatherapy.

> Marked cardiac insufficiency, cardiac accidents, are the causes of a great proportion of death cases especially observed in serious, hyperpyretic malaria. They seem to be promoted by previous heart diseases, so that careful investigations should be made in order to detect any sign of cardiac insufficiency. Certain authors even advise to systematically have an electrocardiogram taken. In practice, however, it seems that the clinical examination ought to be sufficient.

Another contraindication is the presence of a large aneurysm, and advanced arteriosclerosis with or without hypertension. On the other hand, discrete arteriosclerosis, mild aortitis, or well compensated cardiopathy are no contraindications. They merely call for caution and active attention. Electropyrexia is better tolerated than malaria, but the contraindications are identical.

Transthoracic irradiations with short or long waves are also poorly tolerated in cases of myocardial deficiency. The blood pressure, even though low, falls lower still. In subjects affected to a lesser degree, by watching the effect of the treatment every two minutes on the sphygmomanometer, we have observed a transient alternating pulse occurring after intensive irradiation. In short, a failing heart is a contraindication to any intensive treatment. If a local irradiation is attempted, it must be very moderate in dosage, and discontinued at the first myocardial sign.

Attempts were made to treat endocarditides. The first pyretotherapeutic experiences were unfortunate. In our service at the Broussais Hospital, we did not obtain any results in the treatment of Osler's disease. We were just as unsuccessful in resorting to shock producing, thermogenic medications (colloidal or peptone injections) in the treatment of streptococcic endocarditis, and evolutive cardiac rheumatism. In fact we even observed a transient aggravation of the myocardial condition.

Transthoracic irradiations by short waves have been subjected to few experiments. Cignolini obtained a functional improvement of the dyspnea and malaise in streptococcic endocarditis, but was unable to prevent the fatal issue. Schliephake reports that a case of infectious endocarditis, with negative hemoculture, was cured after 15 seances of short waves. Such an isolated observation is inadequate under the circumstance.

### Angina Pectoris

The treatment of angina pectoris by short waves (which we were first to publish) seems to be gaining in greater favor, in spite of the absence of any precise technic. Before the advent of short waves, except for some rare favorable opinions, very few physicians had taken the chance of applying conventional diathermy. Nagelschmidt (cited by Bordier), Delherm, Zimmern, Morel-Kahn, reported good results. "It should be noted (Bordier wrote in 1927) that until recently no one seems to have been interested in treating angina pectoris by diathermy. Yet this very serious disease is worth our trying to benefit by this new

therapy." He published one single observation. In 1925, Lian and Descouts published six cases. They gave a strong dose of over one ampere with pre- and retrocardiac electrodes, and daily treatments of 20 to 30 minutes, with a total of ten to twenty applications.

We have been employing irradiations by short waves since the beginning of 1932. Later Dausset, Giroux, and Yacoël have confirmed our results. Cignolini adopted our method integrally. Three different technics may be applied in the treatment with short waves. The first two we shall mention briefly.

Halphen and Auclair treated a few patients by electropyrexia, their first three cases having been reported by Yacoël at the Quebec Congress. Their dosage was of moderate intensity, and combined with local applications. It is therefore impossible to evaluate the part played by the fever from that by the transcardiac irradiations.

Applied with a moderate intensity, transcardiac diathermy gives good results, and it was our impression during the past two years that it was easier to maintain such dosage in patients presenting angina of long standing with variable blood pressure, who always run the risk of an attack during the seance. In one case we saw too intense a treatment provoke a rise of the blood pressure of 15 to 20 Hg with a paroxysm of pain. Such accidents however are rare. At present, with a precise technic, we prefer to use short waves in all cases.

*Technic of Local Application.* — We administer a series of eight to twelve treatments, at first every two days, then every third to fourth day for 8 to 15 minutes. The anterior condenser electrode in our present technic has a diameter of 15 cm. and covers the precordial region. The posterior electrode, smaller and rectangular, is laid along the spine, centered over the second dorsal. It covers at the same time the projection of the aorta (D4) and the origin of the cardiac sympathetic nerves. With very nervous patients we place the condenser pad sometimes at the base of the neck, covering the stellate ganglion.

The energy used is of medium intensity, about 100 watts. The patient must only feel a moderate and agreeable sensation of heat. The cutaneous temperature measured after the treatment with Saidman's electrical thermometer remains near 36 degrees C. We have not adopted the excessive low doses of Weissenberg, as in our opinion we require a rather pronounced degree of energy.

The wavelength may vary between large limits. The same effects can be observed between 6 and 16 meters. Wavelengths over 18 meters have given us only failures, this without our ability to determine the cause. Whichever wavelength was used, we placed the electrodes very near the skin to guard against excessive depth dosage.

Control of the patient requires that systolic pressure be taken every two minutes. This supervision is necessary with most patients only during the first two or three treatments, while in a few subjects whose pressure is unstable, or when there are periods of repeated painful attacks, every treatment must be so checked.

The blood pressure fluctuates during these treatments. It rises slightly in the first minute, then drops slowly in two to ten minutes from 1 to 4 cm. under the starting point (measured on a patient who has been resting a long while). If the treatment is extended twenty minutes, the pressure has a tendency to rise. Several minutes after the conclusion of the treatment it regains its first value. In certain patients, the pressure rises. Irrespective whether they are affected with hypo- or hypertension this rise if it lasts and remains stationary, is likely to precipitate an attack and the electric current must be shut off. The treatment renewed with a weaker dose may be followed by a drop of the pressure. Too intense an application can make the pressure rise suddenly and bring

forth an anginal paroxysm. It is only a few who have a stable pressure and remain almost indifferent to the irradiation.

### Therapeutic Results

Global statistics and the results of the treatment in relation to particular characteristics of the angina syndrome have been studied with a view of obtaining comparative data for a definite impression of the degree of usefulness of the treatment. We have collected 56 observations during five years, but purposely omit those cases where the treatment was not sufficiently continued, through the patient's fault. The immediate result was excellent in 18 individuals, that is only one-third of the total. The patients have promptly ceased to suffer and the capacity of their physical effort has risen.

Late results were excellent in 22 cases, moderate in 11, poor or without effect in 23. Four of the 18 cases which rapidly improved, soon started to show relapses. While 8 others completed the short wave course without any evident improvement, in the months following, they were able to resume work and appeared to have been completely benefited. For this reason they are grouped as those who have been improved by the treatment.

Good results in general, were observed in patients with slight arteriosclerosis without insufficiency of the left ventricle, and with a small rise in blood pressure of about 15 to 18 cm. They suffered at the least physical effort, especially from cold, and after meals. They were awakened by attacks, often in the middle of the night and at dawn, and required nitroglycerin several times each day. Good effects were sometimes striking after the first treatments. The patients who before could hardly walk without pain, were enabled to increase their capacity of effort and freed of their nocturnal attacks, so that they needed lesser doses of medication. This improvement was usually observed toward the fifth or sixth treatment, a few requiring 10 to 12 sessions. No case should be regarded as a failure until ten treatments have been given.

While this improvement should not be underrated, it by no means is to be interpreted as a cure in the full acceptance of the term. The patients are comfortable subjectively but cannot overstep certain limits of activity, particularly mental stress and physical efforts. The subjective improvement may last months or even years, a few patients returning each year for a few treatments. It was noted that if these secondary treatments did not ameliorate the existing condition to the degree that was first obtained, we had to deal with a serious organic cardiovascular change, which in some instances manifested itself as a premonitory warning of a lethal consequence.

In eleven cases (20 per cent) only moderate improvement was attained, so that the continued though lessened pains prevented resumption of an active life. The benefit consisted essentially in a diminution of the spontaneous attacks. This unsatisfactory relief was of short duration. Relapses occurred after a few weeks or several months. Nevertheless these patients ascribe a high value to the rest-cure associated with the treatment, and request additional treatment.

Twenty-three cases (40 per cent) showed no response to the therapy. Of these patients 8 may be grouped as those who did not tolerate the treatment, the irradiation having aggravated precordial distress. If the current was not shut off, the pressure rose abruptly and provoked an attack of angina pectoris. A few of this group tolerated a very weak dosage.

In 5 cases which we group as refractory, the vascular reactions remained normal, pressure sank two or three degrees, and the treatment otherwise was well tolerated, but the effect on the pains was nil.

In another group of 5 cases, which at first gave the impression of being

improved, the pains recurred after the fourth or fifth session and continued in spite of additional irradiations.

We have also observed 5 patients with cardiac insufficiency. Of these, 2 had a myocardial infarct and 3 manifested left ventricular exhaustion at the terminal stage. Naturally the treatment had merely a psychologic value.

*Effects on Blood Pressure.* — The immediate reactions permit of no prognostic interpretation. The favorable cases have shown a drop of 1 to 3 cm. of mercury during each treatment, with a general tendency to lowering the systolic pressure during the series of treatments. The types with a rise of the systolic pressure presented an unfavorable prognosis. This however is not absolute, as cases with excellent reactions have not improved, while others which in the beginning of the treatments had no lowered pressure, later reacted normally and with excellent effect.

Out of the 49 observations the initial pressure in 24 was not influenced by cardiac weakness and had an average systolic rate of 17 cm., while 25 had 16 cms. and less. Of 31 favorable cases, 19 had high and 12 low pressure, and of the 18 unfavorable ones, 6 had high and 12 low pressure. Accordingly the favorable cases with pressure over or equal to 17 amounted to 57 per cent, and the unfavorable ones, 33 per cent. The high pressure therefore proved more favorable and the low pressure revealed a rather unfavorable prognosis.

*Results on the Cardio-Aortic State.* — Among the patients in a state of frank cardiac insufficiency, we encountered one infarction, one with a rapidly fatal acute systole, and 5 with left ventricle insufficiency. Two showed improvement of short duration, the other 3 having been refractory. In our experience when angina pectoris was due to exhaustion of the myocardium that resisted cardiotonics, short wave irradiation proved futile.

We had good success in 32 patients with cardiac or aortic lesions without characteristic insufficiency or with good compensation. Of these 11 returned to full normal activity, 7 returned to work of a limited nature to avoid bringing on precordial pains, 6 others had moderate results, and 8 proved failures.

Of 17 patients with no noticeable lesion, cardiac or aortic, 4 obtained good results, 3 moderate, and 10 were complete failures. These failures cannot be explained by the gravity of the affection, as we had only one death, a woman of 48 years, with a pressure of 14, and free from any noticeable lesion by physical examination, x-rays or electrocardiogram. Several patients were improved by other treatments, or even spontaneously, and they are at present relatively well.

To sum up, the proportion of failures was 25 per cent for cardio-aortics without cardiac insufficiency, and 60 per cent when there were no cardio-aortic lesions.

From the point of view of the age as a factor we had —

| | | |
|---|---|---|
| Over 70 years | 7 favorable, | 4 unfavorable |
| Between 55 and over 70 years | 14 favorable, | 8 unfavorable |
| Under 65 years | 10 favorable, | 6 unfavorable |
| Total | 31 favorable, | 18 unfavorable |

The proportion of favorable cases is therefore respectively, 63, 63, and 62.5 per cent, that is, approximately the same for the three groups.

Nocturnal attacks were noticed in 23 cases with 11 favorable and 12 unfavorable results. The ratio therefore is approximately even. Thirteen observations revealed severe attacks, far apart with persistence of a relatively good condition, and few pains in their intervals. Of these only 2 have yielded and 11 remained refractory. Severe attacks with prolonged intervals may therefore be regarded as unfavorable.

From what has been said it is seen that there are great chances of improve-

ment in effort angina, irrespective of nocturnal attacks or age. The most favorable forms, are those where the blood pressure is relatively high (over 17), and where stethoscopic and radiologic signs of cardiac or aortic lesions exist, with exhaustion of the myocardium. The proportion of success reaches 75 per cent. The chances are not so great, when no cardiac or aortic lesion exists, especially when accompanied by low pressure.

There are two positive contraindications: (1) non-compensated cardiac insufficiency, and (2) angina pectoris characterized by intense paroxysms with long intervals. In all cases the treatments must be guarded and constantly checked with the sphygmomanometer in place, so as to reduce the intensity of the electric field as soon as the pressure tends to increase. The method is valuable provided it is carried out by a cardiologist.

## High Blood Pressure

High blood pressure undergoes the greatest variations by artificial fever, and especially during regional irradiation. Nearly all applications of a certain intensity produce alterations which in the overwhelming majority take the form of a transitory fall of the systolic pressure. Numerous attempts have been made to treat high blood pressure by physical agents or by pyretotherapy.

*Pyretotherapy.* — The first article on the treatment of high blood pressure was published by Mauriac. He was struck by the fall of the pressure during provoked paludism in a patient with neurosyphylis, complicated by high pressure. When the attacks ceased, the pressure remained low for a few weeks and slowly returned to normal, but the functional disturbances, in particular cephalemia, attributed to the high blood pressure, did not return. Mauriac then proposed that certain patients afflicted with high blood pressure should be given systemic malariatherapy.

Fribourg-Blanc discussing the inevitable hypotension occurring in patients with artificial paludism also recommends pyretotherapy for hypertension, but he prefers short wave radiation to malaria.

Halphen and Auclair state that the fall of the pressure in cases with high pressure is the rule. It reaches 2 to 3 cm. of mercury at each treatment by electropyrexia, rising after the first few treatments, and then falling several centimeters below the initial level. This prolonged reaction reached 10 cm. in one case. The result thus obtained lasts several weeks or several months. The functional disturbances, cephalemia and disturbed vision remained improved, even when the pressure went up again.

Yacoël estimates that the high blood pressure only falls for a short time. But electrohyperpyrexia in individuals without signs of cardiac insufficiency is worth trying because of the functional improvement. The result would be more favorable in cases of high blood pressure due to the menopause.

*Generalized Diathermy Without Thermic Elevation.* — It will be recalled that applications with the d'Arsonval current were early advocated by Bordier for high blood pressure. Bordier asserts that diathermy produces a fall in the pressure which rises in the course of the first few minutes, then falling below its initial rate. Generalized diathermy or autocondensation can be used with great intensity. Abundant perspiration must be provoked in a few minutes. The duration of treatment is half an hour. The blood pressure falls as early as the first treatment and continues to do so in the course of the subsequent 8 or 10 sessions. This is substantiated by Cumberbatch and by Duhem (1921).

Short wave irradiation gives about the same results. In our department at the Broussais Hospital we have treated 22 cases of high blood pressure, 16 women and 6 men, with Leroy's 15-meter apparatus, two big electrodes placed under the bed a few cm. from the skin, one under the lumbar region, the other under the thighs (Laubry, Walser, Deglaude, unpublished work). Of a total of

6 treatments the first lasted 10 minutes, the following 15 minutes administered every other day, with all medication stopped.

The rectal temperature was unchanged, or at the most, there was a rise of 0.2 or 0.3 of a degree. Five minutes after the start of the treatment the pressure falls, the pulse is slightly accelerated, then the pressure again rises slowly, without reaching its former rate. From one treatment to another the systolic pressure tends to fall. The treatment is well tolerated. Some patients are subject to a little nervousness and fatigue after the first treatment.

*Functional Disturbances.* — In 8 cases out of 22, there was considerable improvement, even complete disappearance of cephalemia, vertigo and giddiness which had previously resisted all therapeutic measures. In 7 cases the result was good, the patients admitting a lessening of their discomfort. In 7 cases short wave radiation resulted in either a slight improvement or complete failure. The improvement obtained continued several weeks to a few months.

*Blood Pressure.* — In two patients the pressure rose slightly; in two others it remained unchanged; in 18 cases it fell distinctly. The fall mostly affected the systolic pressure, from an average of 3 cm. of mercury, reaching 5 to 7 centimeters. The diastolic pressure also was lessened but at smaller proportion — 0.5 to 2 cm. of mercury.

The functional improvement observed is not in direct relation to the lowered pressure. In the 8 most favorable patients the fall of the systolic pressure averaged 3 cm., the diastolic 6 cm. In the 7 moderately improved cases the lowering amounted to 3.7 and 1.4 cms. while in the poor results we observed a fall of 3 and 0.7 cm. There were instances when the variations of the pressure and the improvement persisted four to six weeks after the blood pressure had risen above that before treatment.

In general, the highest blood pressure were the ones benefited most by short wave radiation. The treatment seems especially efficient against cephalemia and to a lesser extent against giddiness and vertigo. Repeatedly patients have reported a spontaneous increase of diuresis after the treatment, a lessening of nycturia, fatigue, and pains in the joints, and an increase in the capacity of movements. The precordial pains and angina on the contrary appear hardly to be influenced by general short wave irradiation. Mental relaxation and avoidance of over-exertion are not to be ignored in this form of therapy.

*Local Irradiation.* — Blood pressure can be lowered by the various methods of local irradiation, the degree depending upon the position of the electrodes.

Transcerebral irradiations of weak intensity, but of comparatively longer application ordinarily reduce the tension by several degrees. One of our patients who had luetic hemiplegia had one month after malaria therapy a pressure of 20/10, which rose suddenly to 26 under the influence of bi-temporal irradiation with an 18-meter wavelength of moderate intensity. It fell to 18 in two minutes simply by decreasing the intensity. During the last treatments the pressure started regularly at 20 or 21 and fell rapidly to 18 cm. Hg.

Lazio and Weisel, and Raab have reported irradiation with two electrodes, on the forehead and the nape, for about 30 minutes. The pressure sank for an hour, then rose, with the functional disturbances due to high pressure having improved.

We have had considerable experience with transmediastinal irradiation of angina pectoris. The pressure does not always fall. An excess of energy tends to raise it abruptly. To lower it the irradiation must be of low intensity. We see patients who are sensitive and others refractory to all forms of radiation. In patients who have no angina the drop of the pressure is insignificant and of short duration, at least under the usual conditions of irradiation. This method is therefore not a reliable one in these instances. Irradiations of the carotid

sinus, according to Cignolini, causes a rise of pressure. We have been unable to confirm this observation. There are two methods of abdominal irradiation, the electrodes over the pubic and lumbar region, or over the epigastrium and sacrum. A rather high energy can be given without inconvenience for 30 minutes with large plates. Though intestinal colic may occur, this application seems to be the most efficient. In about 10 observations the pressure fell and remained low several weeks.

We have obtained comparatively good results by intense heating with short waves or diathermy of the muscular masses of the extremities according to Buzanco's technic. Reduction of pressure has been noted irrespective of the localization of short wave or diathermic irradiation. The same was observed also with the continuous current, which does not produce a rise of pressure. Intense dosage of the irradiation has durably lowered the arterial tension in some patients. One encounters types in which no measure produces a reduction of the pressure, while in others any form of treatment results in such an effect, which, however, is difficult of being maintained. Accordingly it seems appropriate to utilize the simplest and least harmful method, such as irradiation at an intensity which does not increase the blood pressure.

The manner in which either local irradiation or general short wave applications in the form of pyretotherapy affect both angina pectoris and high blood pressure is not yet definitely established. Undoubtedly there is an underlying effect on the sympathetic nervous system which apparently reacts more favorably to low intensities of local short wave irradiation. That the thermic effects play a role need not be doubted, physiology having taught us the value of heat both as a stimulant and as a depressant on a large number of pathologic processes.

Note. — Limitation of space compelled the elimination of an extensive bibliography provided by the authors. — Ed.

## Effects of Heat, Cold, and Other Stimuli Upon Human Circulation

**Dail and Moor**

(*Continued from page 143*)

isms. The immediate remedy at the time of chilling is obvious. The application of peripheral heat after infection has become established would not be of nearly as much value.

The question has been raised, Does the taking of a cold bath in the morning have any injurious effect? You must remember that the effect of these peripheral stimuli, how much vasoconstriction is produced by them, is largely determined by the previous condition of circulation. You will get a much more marked vasoconstriction upon the application of a cold stimulus if your skin vessels have been previously dilated. It was observed by Pickering and also by us, that our best results in these experiments are obtained when the room temperature is not too high. When we have warm weather in Southern California during the summer while we are doing these experiments we have to be careful to cool our room as much as possible. When we have room temperatures up around 80 or 90 degrees, our results were not nearly as striking. In other words, skin vessels are dilated by these high temperatures and we cannot get so much dilatation by the additional application of heat.

The question of the application of cold to the head in a general heating procedure, such as hot baths, steam baths, and Turkish baths, is interesting. There is some doubt about the vasomotor supply to the vessels of the brain. These cold applications to the head doubtless do not produce their effect by a vasomotor action. I have heard this explanation made by a physiologist and it looks very reasonable to me. The major supply of blood to the brain is through the internal carotid. That is not the whole supply but the major supply. If we apply cold to the face and head, the branches of the external carotid will be constricted, thereby throwing more blood into the internal carotid and therefore giving us a greater blood supply to the brain. The danger then of excessive anemia of the vital centers is produced by large application of heat to the periphery, which would be offset somewhat by an application of cold to the head and face.

# ELECTROSURGERY OF CANCER OF NASAL ACCESSORY SINUSES *

EDWIN N. KIME, M.D.

INDIANAPOLIS

During the past decade we have removed more than five thousand neoplasms from the head and neck, by electrosurgical technic. End results have been excellent in all cases except those with deep seated cancer (2 per cent). These deep lesions of the head had arisen, either internally or externally. When external, the usual history was incomplete removal by scalpel, caustic, cautery, improper electrosurgery, or inadequate radiation by radium and x-ray. Even when one or many prior methods had failed, radical electrosurgical excision has often succeeded in prolonging life, by removing the septic neoplasm in larger portion, if not in toto. Such radical resections of neoplasm, bone, radiation cicatrix, etc., cannot be accomplished without more or less extensive mutilation. The convalescence is tedious and prolonged. Follow-up biopsies, sequestrectomies, skillful nursing, proper diet, special attention to the wound to prevent post-operative sepsis, ligation of major vessels, and the multiple factors associated with plastic repair — all enter into the picture. The problem of exenteration of the orbit with sacrifice of vision not infrequently arises. Cooperation between the electrosurgeon and other specialties is essential. In addition to the all important family physician, whose competency as the first consultant of the potential victim of cancer determines his ultimate fate — the following specialistic services are often required: the otolaryngologist, ophthalmologist, pathologist, radiologist, stomatologist (dental repair), and the general surgeon (problems of gastrostomy, blood transfusion, plastic repair).

We are glad to give due credit to these other departments for whatever degree of success we have had in the management of cancer of the nasal sinuses. Lest our attitude toward radiation be misunderstood, we emphasize that the problem of radiosensitivity must be considered in every neoplasm. Even though radiation may have apparently failed to cure the primary lesion, we do not hesitate to use it again after electrosurgery has apparently eradicated the visible growth in the more extensive cases. The combination of electrosurgery, radium and x-ray therapy often gives five to ten year cures in cases which were obviously incurable by either method alone.

## Histogenesis of Cancer of Nasal Sinuses

Squamous celled or epidermoid cancer is the most frequent type in our experience, and arises either within the epithelial lining of the sinus (usually the antrum) or in the buccal mucosa. Our best results have been in epidermoid cancer, which had arisen externally. The next in frequency is basal cell cancer arising in seborrhoeic keratosis of the face, nose or about the orbit. This so-called "benign rodent ulcer" which could have been easily cured months or years before it had been allowed to infiltrate into the diploic bone, gradually and inexorably brings the patient to a "slow, progressive, hopelessly incurable, painful and stinking death." The lethal exitus rarely occurs as a result of distant or general metatases in either of the epidermoid types of cancer of the sinuses. I have seen epidermoid cancer infiltrate from

* From the Oncologic Clinic of the Indianapolis City Hospital.
* Read at the Sixteenth Annual Session of the American Congress of Physical Therapy, Cincinnati, Ohio, September 22, 1937.

the mouth through the antrum, into the orbit and ethmoids, without any extension into the neck. Again I have seen basal cell cancer destroy one orbit, infiltrate into the ethmoids and frontal of both sides, then the other orbit before involving the cranial cavity. Again I have seen a radio-resistant growth, not cured by electrosurgery, which destroyed the entire central skeleton of the face, the patient ultimately dying from sepsis (aspiration pneumonia) and not from cancer. In still another case I was able to cure by electrosurgery a radioresitant basal cell cancer of probably forty years duration. The growth began in the malar region, ulcerated into the antrum, but remained localized in its outer wall. This patient lived almost five years — and died at the age of 84 from cardiovascular-renal disease. The family physician, who must attend incurable patients, is often too pessimistic about our ability to control cancer, and to cure it while in its early low grade localized stage. The dentist who treats chronic sores in the mouth, should not only be on his guard against lues, but also insist upon biopsy and electrosurgical eradication if the growth is epidermoid carcinoma. The otolaryngologist should become more proficient in electrosurgical technic within the nose. Electrosurgical biopsy is safe and efficient in most cases. Even when the polypoid material removed from the ostium of the sinus is negative, cancer may lie behind it in the walls of the sinus. If the surgeon waits in every case until transillumination is definite, and radiographs show bone erosion, he will usually have waited beyond the stage of curability.

It is true that adenocarcinoma arising within the sinuses is almost hopeless. Spindle celled sarcoma has been often fatal in the cases we have seen. Round celled sarcoma has been fatal in every case. The simple epulis within the mouth, may prove under the microscope to be a fibro-sarcoma. It should be eradicated chiefly by electrosurgical technic before the alveolus has been penetrated and the antrum invaded.

### Management of Cancer in Nasal Sinuses

It is evident that early accurate diagnosis of type, grade, and extent of the growth is highly important. Good exposure is essential. The Caldwell Luc exposure may suffice for diagnosis, but not for complete eradication of cancer of the antrum, because the orbit and ethmoids are also likely to be involved. Despite the likelihood of an external scar, a facial flap over the suspected sinus should be raised and sufficient exposure obtained by rongeur to uncover the gross pathologic process. Special attention should be given the orbit. Frozen sections are invaluable at time of operation for the important question whether the orbit should be exenterated. If the orbital fat contains cancer it is our practice at this time to sacrifice the eyeball, and completely clean out the ethmoids. Bleeding points are electrocoagulated. If prior ligation of the carotid has been done, there is little bleeding in most cases. Occasionally we have encountered considerable bleeding from vessels anastomosing across the midline. A hemostat applied to the spurting vessel and its electrocoagulation through the instrument is effective for arterial hemorrhage. Fulguration is used for venous and capillary oozing from rongeured bone. Especial care must be exercised when operating in the roof of the orbit and along the cribriform plate. The operator must avoid, if possible, any hiatus into the cranial cavity. It is true that after operation the orbital plate may slough and the dura may be exposed, but if the dura has not been damaged at the time of the operation no serious infection need arise. In the aftercare of these wounds we use routinely 2 per cent gentian violet, 10 per cent acetone-alcohol solution, or 1 per cent methyl violet ointment. The cavity is always lightly packed. Dressings are done daily. The patients are often out of bed on the third day, although

a low grade fever from absorption will usually occur. Heavy morphinization is seldom required. In the general anesthesia for the operation, we usually employ avertin, followed by ether. We have had no ether explosions. The anesthetist, however, is instructed to put the patient well down with ether and then does not administer any anesthetic while the operation is proceeding. After the operation is completed, we usually administer one or two ampules of coramine until the patient is awake. After-pain and shock, are seldom present to any great degree.

In the routine postoperative management, sloughs are removed as they appear. After the wound begins to granulate, bone sequestra are removed and follow-up biopsies are done on any area that looks suspicious of continued carcinoma. Plastic repair is not started until these biopsies are negative.

## Summary and Conclusions

1. Electrosurgery is invaluable in the eradication of early low grade localized or radioresistant cancer of the nasal sinuses.

2. Classic operative technic, bone resection, ligation of major vessels and plastic repair are also required in most cases of cancer in the nasal sinuses. Electrosurgery occasionally obviates ligation and extensive resection.

3. Electrosurgery for cancer of the sinuses presupposes specialistic technic, fortitude and better than average familiarity with the surgical anatomy of the head and neck.

4. Electrosurgery in conjunction with radiation is valuable in the control of cancer in the head. Palliation is always possible except in the very latest stages. Five to ten year cures have been obtained in some cases.

5. Electrosurgery, properly performed, and controlled by microscopic examination, is effective in the prevention of deep cancer in the head and neck unless it has arisen internally.

6. Electrosurgery often enables the physician to demonstrate the truth of the slogan of the American Society for the Control of Cancer: "Early Cancer is Curable." In our present campaign against pessimism, apathy, fear, ignorance and stark despair, we may well fight cancer with knowledge. Not the least of this education needed, is knowledge of the possibilities of electrosurgery in the prevention and cure of cancer of the head and neck.

711 Underwriters Building.

---

## New York Physical Therapy Society Meeting

The regular March meeting of the New York Physical Therapy Society will be held at the New York Academy of Medicine Building, Fifth Avenue at 103rd Street, New York, March 2, at which the following program will be presented:

1. New Instruments — (a) Special Electrodes. (b) Tube Machine. All Modalities of Static Electricity — *Myron Schwarzschild and Samuel Gottesman,* M.D.

2. Peripheral Vascular Disease — Review of Recent Literature — *Karl Harpuder,* M.D.

3. Electrotherapy in Fibromyositis — *Norman Titus,* M.D.

Discussion opened by *Charles Murray Gratz,* M.D. (by invitation); *John P. Stump,* M.D. (by invitation).

4. Recent Advances in the Treatment of Foot Disabilities with Special Reference to Prophylaxis. Slides, Movies. *Jerome Weiss,* M.D., and *Hans J. Behrend,* M.D.

Discussion opened by *Walter I. Galland,* M.D. (by invitation).

*Farel Jouard,* M.D., President, 120 West 70th Street, New York.

*Madge C. L. McGuinness,* M.D., Secretary, 1211 Madison Avenue, New York.

# PASSIVE VASCULAR EXERCISE IN PERIPHERAL VASCULAR DISEASES *

GEORGE H. YEAGER, M.D.

BALTIMORE, MARYLAND

Since January, 1934, when Reid and Herrmann presented their paper on the use of special environmental exercises in the treatment of peripheral vascular diseases, a great deal has been written on this form of therapy. Comparison of the various articles reveals that the subject is controversial, and that reports differ in the end results obtained.

The possible factors influencing such contrasting conclusions are varied and too many to enumerate at this time. However, it may be suggested that it is no more rational to use passive vascular exercises as the sole therapeutic measure in the treatment of peripheral vascular diseases, than it is to institute only one form of therapy in any disease process, regardless of its character.

Landis and Gibbon have shown that if an extremity is placed in a negative pressure environment, there is an increase of the blood flow volume to that extremity, and a rise in its surface temperature. Since February 1934, I have been using alternating positive and negative pressure in the treatment of organic peripheral vascular disturbances, a detailed report of which will be submitted at a later time. Suffice it to say at this time, that there have been many discouraging and unsatisfactory results. However, in all fairness it should be stated that many of the failures were probably due to a poor selection of cases. This is particularly true of the arteriosclerotic peripheral vascular disturbances with fixed sclerosis of the arterioles. Conway recently called attention to this fact, and stated that in his series of cases of this type a radical operation was subsequently performed.

Another group in which passive vascular exercise has proved inadequate is that of a fulminating form of thrombo-angiitis obliterans. Despite sympathetic nerve surgery, supportive measures and passive vascular exercises a radical amputation was necessitated in the cases coming under my observation.

Thus, like any other single therapeutic measure there is a certain percentage of failures, just as there is a certain percentage of successful results. Fortunately, the latter far outweigh the former. Combined with various supportive measures, passive vascular exercises offer a method by which the incidence of amputation has been commensurately reduced. Compared with other measures to stimulate collateral circulation, it certainly appears to be more effective than any other known single method.

## Case Reports

Any procedure that lessens the incidence of amputation certainly justifies its being regarded as one of our most important agents for the stimulation of the collateral circulation, even though its effectiveness appears to be sharply limited. As typical examples in which passive vascular exercises have proved of undoubted value, I cite the following cases:

M. M., white, male, aged 30 years. This patient had symptoms (pain, tenderness, discoloration) referable to the left leg and foot for a period of three years. One year previous to admission to the University Hospital, the second toe of the left

* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1936.

foot had been amputated because of a dry gangrene. The amputated stump failed to heal and at admission he had an unhealed stump of the left second toe, and a perforating ulcer on the plantar surface of the third toe. Both the stump and the perforating ulcer were secondarily infected and showed areas of necrosis. There were no pulsations obtainable in the dorsalis pedis, anterior tibial or popliteal arteries. The foot was cold and cyanotic. There were several red, tender, indurated areas over the leg along the course of the superficial veins. Dermatherm tests showed an occlusion index of 0.2. The patient himself was quite emaciated, and because of excruciating rest pain he entered the hospital desirous of an amputation. General supportive measures were instituted consisting of rest, hygienic measures and intravenous injections of saline solution as suggested by Samuels. At the end of two weeks the therapeutic response was negligible. Passive vascular exercises were started, and at the end of a month there was marked alleviation of pain, and the amputated stump and perforating ulcer had healed. There was a decided improvement in the patient's mental outlook. In two months he was completely free of rest pain and was discharged from the hospital as an ambulatory patient. At the time of his discharge the color of his foot had improved, and there were no unhealed areas. No pulsations were obtained in any of the vessels of this leg. After six months his condition had improved so markedly that he was permitted to return to work. He carried on his duties for nine months quite satisfactorily and without discomfort. During this time he was under continual observation.

He then developed areas of superficial necrosis over the dorsum of the great toe, and red, indurated areas over the course of the saphenous vein. The latter extended to about six inches below the fossa ovalis. He had persistent pain, whether walking or at rest. After four days of complete rest in bed his pain was still persistent and severe. Passive vascular exercises were resumed, the rubber cuff being so arranged that its pressure was above the thrombotic areas along the course of the saphenous vein. There was immediate relief from rest pain. In two weeks time the areas of superficial necrosis about the great toe healed, and he was permitted out of bed. In another week he was discharged from the hospital as improved. He had no pain or discomfort, and all necrosed areas had healed. After two more weeks of ambulatory treatment, he was again permitted to return to his work. At this writing, he is carrying on his duties satisfactorily and without discomfort.

T. M., white, male, age 54 years. This patient had symptoms referable to the left lower extremity for the past three years. These symptoms consisted of coldness, numbness, and paresthesias of the foot and leg. He was unable to walk a block without severe intermittent claudication. At the time he was seen, he had given up his business and was using a cane for support. A diagnosis of obliterative arteriosclerotic disease was made. With general supportive measures, passive vascular exercises were instituted. He responded to treatment most satisfactorily. Within two months his condition had improved to such an extent that he resumed his business. He was able to walk five or six blocks without discomfort. He has been working for the past two years without recurrence or aggravation of symptoms. As an example of the value of combining this form of therapy with others, the following was noted — after four months of treatment his improvement remained stationary. He was then given a series of twelve injections of pancreatic tissue extract. Immediately following this he was able to walk a mile without discomfort or intermittent claudication.

Two cases of acute arteriosclerotic endarteritis obliterans were white females, aged 54 and 62, respectively. They gave a history of acute, excruciating pain in the foot, accompanied by numbness. In both instances there were hemorrhagic areas over the dorsum of the foot (right) with a cyanotic discoloration of the middle toe. No pulsations were obtained in the dorsalis pedis or posterior tibial artery. Blood sugars were normal, and blood Wassermann tests negative. With passive vascular therapy the pain disappeared in twenty-four hours. The entire foot improved in appearance and within two weeks they were discharged from the hospital, with no areas of discoloration, in either instance, and no pain. Observed over a period of two years, there has been no recurrence of symptoms.

T. P., white, male, aged 58 years. This patient had a coronary sclerosis with cardiac irregularity. He developed sudden numbness and coldness of the left lower extremity, with numerous hemorrhagic areas in the subcutaneous tissues. He was seen twenty-four hours after the onset. No pulsations were obtained in the popliteal, dorsalis pedis or posterior tibial artery. There was exquisite tenderness in the popliteal space. A diagnosis of sudden occlusion of the popliteal artery, probably thrombotic in character, was made. Papaverine hydrochloride was given intravenously, and passive vascular therapy was instituted. Despite almost continuous ther-

apy, the foot became gangrenous and amputation was necessitated. Two months after his discharge from the hospital he developed similar symptoms in the right lower extremity. He was seen within two hours after the onset of symptoms. The same therapeutic measures were instituted as for the left leg. The response was satisfactory. Discoloration of the foot disappeared, and sensation returned. After a month of intense therapy an artificial left leg was secured for him and he was permitted to walk about. He has been under observation for the past year without recurrence of symptoms. He walks about with comparative ease, and states that the right leg and foot feel perfectly normal.

In reviewing the clinical history of this case, and the diagnostic findings, I am unable to find any difference, with reference to the two extremities, except for the time element relative to the institution of therapy.

The above cases have been cited to show that while passive vascular exercises are not a cure all, they are applicable to certain types of organic peripheral vascular occlusions. If we have a mechanism that can stimulate collateral circulation, even though temporarily, it is perfectly possible that, after having tided the individual over the acute stage, he will, in turn, compensate of his own accord.

## Conclusions

1. Passive vascular exercises, while apparently ineffective in a large group of organic vascular occlusions, are useful in a large percentage of properly selected cases.
2. The incidence of amputation has been lowered, and, therefore, this form of therapy should be considered an important adjunct in the treatment of organic peripheral vascular disease.

101 West Read Street.

## Bibliography

1. Conway, J. H.: Obliterative Vascular Diseases: Report of Fifty-one Cases Treated with Passive Vascular Exercise, J. A. M. A. **106**:1153 (April 4) 1936.
2. Landis, E. M., and Gibbon, J. H., Jr.: Effects of Alternate Suction and Pressure on Blood Flow to Lower Extremities, J. Clin. Invest. **12**:925 (Sept.) 1933.
3. Samuels, S. S.: Gangrene Due to Thrombo-angiitis Obliterans; Further Experiences with Treatment, J. A. M. A. **102**:436 (Feb. 10) 1934.
4. Reid, Mont R.: Diagnosis and Treatment of Peripheral Vascular Diseases, Am. J. Surg. **24**:11 (April) 1934.
5. Barker, N. W.; Brown, G. E., and Roth, G. M.: Effect of Pancreatic Tissue Extract on Muscle Pain of Ischemic Origin (Intermittent Claudication), Tr. Am. Therap. Soc. **33**:115, 1933.

*(Discussion of Drs. Wright and B. C. Smith will be on page 163)*

# PHYSICAL THERAPY IN PERIPHERAL VASCULAR DISEASE *

IRVING S. WRIGHT, M.D.

NEW YORK

The past decade has seen a marked revival of interest in diseases of the peripheral circulation, the development of new physical therapeutic methods and their critical evaluation. We appear to have embarked on what might be termed a machine age in medicine. While such progress brings certain benefits, there are also insidious dangers which are not at first apparent but which may jeopardize the benefits of the entire forward step. It is my purpose to sound a note of warning that we are faced with the possibility of serious complications by the ill-advised use of our recently developed apparatus.

It was natural and logical to attempt to employ the methods of physical therapy in peripheral vascular disease. Unfortunately, insufficient preparation on the part of many of the physicians has produced undesired results. Correct diagnosis of the various forms of peripheral vascular disease is absolutely essential for rational treatment. That this important link is missing in the education of most physicians has been adequately demonstrated to the satisfaction of all workers in peripheral vascular investigation. In a single year in our clinic at the New York Post-Graduate Hospital, about 65 per cent of the patients referred to us had been incorrectly diagnosed. It is not surprising that the older physicians are not acquainted with the more recent advances in this field, but it is inexcusable that so few medical schools throughout the United States are providing adequate instruction. As a result recent graduates are in most cases uninformed regarding the essential principles of these conditions.

The treatment of senile and diabetic arteriosclerosis, thrombo-angiitis obliterans, Raynaud's disease and erythromelalgia should be individualized since the fundamental pathologic process producing the gangrene or color changes is different in each condition. It is, therefore, unsound for either a physical therapist or general practitioner to treat peripheral vascular disease without adequate experience.

Of especial importance is an understanding of the physiologic and pathologic processes involved, so that grave damage may not result from improper therapy. To be specific, it has been demonstrated that with diathermy and short wave apparatus it is possible to elevate the temperature of the tissues between the electrodes to a considerable degree. While it might be beneficial in some diseases where normal circulation prevails, to raise the deep tissue temperatures to 106 or more degrees may be definitely dangerous in peripheral vascular disease with organic occlusion. When an occlusion as high as the femoral artery occurs in one leg, and a barely adequate collateral circulation struggles to meet the metabolic demands, it is highly probable that increasing those metabolic demands locally in the foot to a point beyond which they can be met by the available blood supply, may result in serious harm. I have seen many patients who have had severe burns following the over-use of deep heat lamps of various types. We should remember that burns involving such tissues with their lowered resistance to infection are much more serious than those of ordinary tissue.

* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1936.

Most of these burns have been infected and have been extremely slow to heal. Several of them have necessitated amputation and one patient lost his life.

This does not imply a sweeping condemnation of diathermy and short wave machines in the treatment of peripheral vascular disease. It seems logical that some use should be made of these methods to procure helpful vasodilatation and to encourage the collateral circulation to take over some of the burdens necessary to the life of tissue, but I do not believe that their general use for these conditions is justified in the light of our present knowledge.

Perhaps the most popular apparatus in use today for the treatment of these conditions is one for pressure suction. Encouraging results have been reported by Landis and his co-workers, Herrmann and many others. Critical reports have been issued from the Mayo Clinic, the University of Chicago and other groups. At present it seems that this type of treatment is of fairly well established value in cases of acute embolism, although here we must be careful to separate that group of cases with apparent embolism due to traumatic arterial spasm and apparent embolism due to thrombosis of the proximal vein. It has also proved useful in frostbite; and in some cases of arteriosclerosis. The presence of infection or phlebitis constitutes definite contraindication for its use. I have seen a number of patients in whom hidden infection was activated by this method. In one series, seven out of ten individuals with thrombo-angiitis obliterans developed acute phlebitis, although the average percentage would run definitely lower than that.

### Employment of Simpler Agents

There are many patients who cannot stand the pain incident to this treatment. In order to justify the use of an elaborate equipment, such as this, it must be demonstrated that similar results cannot be obtained by simpler methods. Time alone will answer this question.

A new apparatus introduced by Collens and Wilensky, which operates on the principle of an intermittent venous hyperemia, has been reported as producing encouraging results in the hands of the originators, but needs further observation for general use.

Iontophoresis with acetyl-beta-methylcholine chloride, as reported from our clinic, seems to be of at least temporary value in the treatment of Raynaud's disease and scleroderma, and I believe is of proved value in the treatment of chronic varicose and post-phlebitic ulcers. A word of warning regarding the possibility of burns through this form of treatment. If the asbestos material is not completely intact, it is possible to cause a severe and prolonged burn. The technic described by J. Kovács should be followed in minute detail in order to protect the patient.

Since wet dressings and baths are widely used in the treatment of these gangrenous conditions, it is desirable that they should be maintained at a temperature which is not above 98 degrees and does not fall below 90 degrees. It has been frequently observed that wet dressings in most hospitals soon become cold and produce a definite spasm of the small vessels locally, thus inhibiting the circulation and healing.

The use of the ordinary cradle and lamp combination, on the other hand, frequently results in an elevation of temperature too high to be safe, and again we are confronted with the problem of increased metabolic demands upon the potential blood supply. Starr has demonstrated the need for thermostatically controlled heat. This can be obtained by either a thermostatically controlled cradle or lamp, or, less satisfactorily, by a thermometer in the cradle, by which an ordinary light bulb can be regulated.

The temperature should be maintained between 90 and 95 degrees F., to secure the best results. A wet dressing in a cradle so controlled will usually be maintained at a satisfactory temperature.

Encouraging results in the treatment of peripheral vascular disease have been reported following the use of various types of apparatus to increase the body temperature as a whole, as, for example, the Kettering hypertherm. Insufficient work has been done thus far with these machines to prove that they have a therapeutic efficiency greater than can be obtained by the intravenous administration of typhoid vaccine.

It is obviously impossible to include in this discussion all of the methods of physical therapy which have been used in the treatment of peripheral vascular disease. I have, however, endeavored to stress those of major importance, emphasizing particularly the need for a more careful and critical approach.

115 E 61st Street.

## Discussions

**Dr. John H. Gibbon** (Philadelphia): I was much interested in Dr. Smith's use of a machine in which the length of the negative and positive pressure cycles could be varied. I am sure that it could be beneficially employed but only under the direct and continuous supervision of a physician, a condition not always practicable or possible. The fixed timing by Landis and Hitzrot was employed in order to simplify the clinical application of the suction and pressure apparatus. Twenty-five seconds of negative pressure was chosen as approximately the longest time which could be safely employed without producing congestion of the foot in patients with a mild grade of organic occlusion of the blood vessels. The five second period of positive pressure was selected as the shortest period in which complete emptying of the vessels of the skin and of the veins can be obtained. In our preliminary work, Landis and I noted that with maximal vasodilatation in a normal person at the end of 20 seconds' negative pressure of 120 mm. Hg. congestion was obvious in the foot. At the end of 25 seconds the congestion became distinctly uncomfortable. In patients with an impaired blood supply to the foot it was felt that a period of negative pressure of at least 25 seconds could certainly be borne without discomfort or without any loss of efficiency due to congestion and filling of the vascular bed. Indeed it was thought probable that in patients with very marked diminution of the blood supply to the foot even longer periods of negative pressure could be used effectively without causing discomfort. We are still of the opinion that shorter periods of negative pressure result in inadequate filling of the parts with blood and loss of efficiency.

I was interested in Dr. Wright's remarks about the harm which may result from the use of excessive heat in limbs in which there is an inadequate blood supply. I suppose the application of heat to such a limb seems to be a rational form of treatment. Dr. Wright has pointed out the dangerous increase in the local metabolic need for oxygen engendered by this therapy. If any benefit accrues from such treatment, it can only be due to the vasodilatation of patent collateral vessels to the extent that the increased local need for oxygen is more than compensated by the increased blood supply, an unlikely contingency. It is far more logical to produce vasodilatation by raising the temperature of the body as a whole or by drugs, alcohol, or procedures which block vasoconstrictor impulses to the vessels involved.

I have had no experience with Dr. Veal's method of arteriography and consequently I speak without authority on its use. As an objective method of estimating the degree of inadequacy of the circulation to an extremity it appears to me to be inferior to the quantitative method of measuring the skin temperature of the digits following some procedure which eliminates complete vasoconstrictor impulses to the vessels, as originally proposed by Morton and Scott, White and others. This appears to me to be a much safer objective criterion of a change in the blood supply to a part, following some form of therapy, such as the suction and pressure treatment.

**Dr. Edward A. Edwards** (Boston): Dr. Wright has pointed out the harm to the individual patient when an incorrect categorical diagnosis is made. But this has even more meaning in its misleading statistical inferences. So, for example, the idea has in the past been current that diathermy and other forms of heat would benefit vascular disease. We know now that such treatment may actually produce gangrene in the presence of organic obstruction; while the benefited cases were probably those with vasospastic syndromes, and with little or no organic obstruction.

Dr. Smith and Dr. Veal have pointed out the further value of what we may call the structural diagnosis, and how this makes more exact the individual patient's treatment and prognosis. Any physician aware of his patient's condition will not confine himself to a stereotyped form of

treatment, but will, as Dr. Smith has emphasized, adjust his treatment to the conditions present.

I wish here to point out that the suction-pressure treatment was not intended to overcome vessel spasm; and may indeed, as Dr. Veal has told us, increase such spasm. Concomitant spasm may be responsible for much of the obstruction in a given case of organic disease. Various methods have been used to overcome this spasm while the patient is being treated for the organic obstruction by suction-pressure. Dr. Veal uses alcohol by mouth; Landis, Gibbon, and Hitzrot an electric pad on one of the untreated limbs, and Herrmann and Reid, alcohol with radiant heat in the treatment chamber. My own preference is for local warmth in the chamber. This gives greater vaso-dilatation than can be achieved by any other means. A simple device to accomplish this consists of two electric warmers, each suspended on either side of the treatment chamber and fed through an adjustable thermostat. The temperature is kept at 90 to 110 degrees F. according to the individual case. I have used this for some time, and find it a valuable adjunct. I again emphasize that this warming is done only while the patient is undergoing the suction-pressure treatment.

What finally does the suction-pressure treatment accomplish when it does produce a beneficial result? So far, no effective agent has been found for restoring the lumen of obstructed main arteries, and this therapy is no exception. Its beneficial results depend, in common with the other forms of treatment, on the enlargement of the available collateral channels. Structurally, then, the successfully treated limb shows a large number of sizeable collaterals, with the main arteries still obstructed. It is interesting that such a peripheral circulation is a normal finding in sluggish arboreal animals, such as sloths, ant-eaters, and lemurs.

It is noteworthy that even after what we consider a favorable outcome in organic obstruction in the human, the oscillometer shows that little or no change has taken place in the pulsations. McNealy and Shapiro have aptly designated the blood flow through these increased collaterals as non-pulsatile. This type of circulation is an exaggeration of the sloth type; and the intermittent claudication which occurs after active exercise, forces the unwilling patient to a hesitant, sloth-like movement. The support of muscular movement is not the only function of the circulation; and we must caution our patients, even after successful treatment, not only to limit their exercise before cramps occur, but also to avoid other metabolic strains, such as trauma or infection, since a non-pulsatile circulation will not support such strain.

Dr. Yeager has expressed the idea that suction-pressure therapy should be thought of as an adjunct. Certainly this idea bears constant emphasis. Some patients may be more benefited by other forms of treatment. Even when physical therapy is indicated, the management of vascular disease cannot end with the proper choice of an apparatus. At any time in the course of arterial disease, spontaneous thrombosis may occur and change the whole picture. The patient with thrombo-angiitis obliterans must still avoid tobacco. The diabetic must still keep his metabolic fault corrected. The arteriosclerotic may need digitalis to bolster a failing central circulation. The patient with a varicose ulcer receives only temporary benefit from iontophoresis. Here, one's energies would be more properly directed, if the veins were treated; since such a cure is the only one which protects against recurrence.

**Dr. Leopold Brahdy** (New York): I have seen many excellent results in the treatment of some forms of vascular disease obtained by physical therapists in this city using widely variant technics, and fortunately none of the bad effects found by Dr. Wright and Dr. Smith. These results warrant the conclusion that no case of peripheral vascular disease should be treated without the cooperation of a physician skilled in the employment of physical modalities.

I would like to call attention to one field in which results are less favorable, and that is in frost bite. This is usually considered as essentially a peripheral vascular lesion. It is a disease which affects several hundred workers in this city every year and leaves a trail of permanently crippled hands and feet. In 1934, I stated in the Journal of the American Medical Association that the conservative treatment of frost bite is unsatisfactory and that one may hope that physical therapeutic methods will in the future give better results. During the past two winters I have watched the effects of such treatment, but those hopeful expectations have not been realized. I know that there are men who hold a different opinion, but examination of their cases shows that they obtained their good results in cases involving mainly the skin and subcutaneous tissues. These cases at first glance look serious because of the extensive blebs, discoloration, edema and pain, but, of course, recover under any form of treatment. Therapeutic efficacy must be judged by the less common cases of white, stiff, cold fingers, or toes, which in spite of any treatment go on to formation of indolent ulcers or bone necrosis.

I would like to echo Dr. Wright's statement that the problem of the correct diagnosis of the various peripheral vascular diseases is one of vital importance and is absolutely essential before a rational treatment can be embarked upon. In applying new methods of therapy we must have a clear vision of the pathological processes. We have long assumed that frost bite is simply a peripheral vascular occulsion, spastic in the early and thrombotic in later stages. In view of the results obtained by methods available in peripheral vascular disease, we should reconsider the assumption that frost bite is mainly a vascular lesion. Cold first causes

a sensory paralysis, anesthesia, and it is because of this anesthesia that exposure is continued and the frost bite progresses to the danger point. Clinically, it seems to me that the ulcers of frost bite resemble trophic ulcers more closely than the lesions of vascular disease. The dry necrosis of bone, without any infection, suggests an etiologic factor other than disease. We must inquire whether sensory nerve paralysis or direct tissue injury is not a more important factor in serious frost bite than we usually imagine. The study of frost bite by arteriography, as described by Dr. Veal, and by the other tests, such as used by Dr. Smith, may give us a clue to a more effective therapy. At present, I cannot visualize that such therapy will be anything but physical in nature. I still hope that it will minimize or obviating the necessity of amputations in frost bites, that the future treatment of this condition will compare favorably with the peripheral vascular therapy described here today.

**Dr. William Collins** (New York): Dr. Wright has mentioned in his very interesting paper a procedure that Dr. Wilensky and I have introduced in the treatment of peripheral vascular disease. I should like to tell you something about it. It is based upon the observations of Sir Thomas Lewis, who published his paper in 1925. If you place a tunic, or a band, about the proximal portion of your extremity and compress it in such a fashion that you obstruct the return of the venous blood and simply permit arterial blood to enter, it is quite obvious that under such circumstances the venous blood will become locked up, and as the arterial blood continues to pump in to the extremity the volume of the extremity will increase in size.

Obviously, you will see under those circumstances that that is what August Bier introduced in 1900 and published what we recognize today as Bier's hyperemia. Sir Thomas Lewis, in studying the phenomenon of Bier's passive hyperemia observed that if you will release this compression band there is an extra inflow of blood, arterial blood in the extremity of a very definite measured amount. He found, first, that during the state of the passive hyperemia, or venous congestion, there was an increase in the arterial amplitude. At the time the extremity reaches its peak when the release occurs, one obtains an increase of arterial flow as great as 600 per cent.

What we did was to construct a device which alternately produces periods of compression, and periods of no compression. We found it to have optimal value when we alternated the cycles at intervals of two minutes. We built the apparatus and placed a pneumatic cuff about the proximal extremity and permitted it to be inflated and released for two minutes and applied it for as long as two hours at a time. That is fundamentally the procedure.

**Dr. N. H. Polmer** (New Orleans): From the symposium presented this afternoon, it seems logical to conclude that in the conservative treatment of peripheral vascular disease physical methods are of great importance. The first great physical agent we employ, and I wish to stress that, is rest. By "rest" we mean rest in bed with the affected extremity on a pillow, and in the acute stage, above the level of the heart. Following this rest is the judicious use of exercise, and in the beginning the passive vascular exercise the technics and merits of which have been discussed by most of the essayists.

While the active exercises, such as described by Berger, Allen and Brown, are physiologically good and sound, our experience has been that patients soon tire of their use and discard them. Next we come to the consideration of heat, positive heat in the form of an electric tent, electric baker, radiant light and heat, diathermy and short wave therapy, all of which produce their physiologic response by vasodilatation and increase of blood supply. The impression of most workers is that the vasospastic cases are improved by these forms of heat through a relaxing influence. Then, we must consider the avoidance of heat, the avoidance of negative heat, the avoidance of cold which is extremely important. The treatment, then, consists of rest, vasodilatation, whether it be by heat, whether it be by iontophoresis, or by other physical methods and the judicious use of exercise.

It has been my good fortune to administer physical therapy to three cases of traumatic aneurysm in the service of Dr. Rudolph Matas, subsequent as well as prior to operation. This was before we had the passive vascular exercising apparatus. In these cases we used contrast whirlpool baths in which the whole extremity up to the thigh was introduced into the hot whirlpool bath until distinct hyperemia and redness was produced. Then, alternately, for a short period, we put them into a cold bath. Dr. Matas was favorably impressed with the increase in circulation, as demonstrated by the Moschowitz test. After a period of rest and physical therapy, these patients were operated upon.

**Dr. Heinrich Wolf** (New York): I would like to direct certain remarks to the statement of one of the speakers, that heat treatment is contraindicated in infectious cases, particularly in wet gangrene. I have tried a number of times to point out that this is physiologically obvious. If we have impaired circulation in the periphery because edema exists and the return flow on that account is hampered, it is obvious that by increasing the arterial blood supply we do not improve the circulation but make it considerably worse, because we get more blood in and less blood out. I would like, also, to say a few words on Dr. Collens' apparatus. I would like to make a suggestion as to where the results could not be explained in this peculiar way. When Bier made his experiments on the value of hyperemia he made the following experiment: He

put on an elastic bandage on the leg of a pig after he had made that leg completely anemic. He amputated that leg without taking off the bandage. Then, he took off the bandage and did not tie the vessels. In spite of the fact that the vessls were wide open the skin below the bandage became red.

Years ago I made some experiments on the kidney. If you tie off the artery to a kidney you will see that the organ increases to twice its size. It occurred to me that it is most likely due to the fact that under such circumstances the wreckage of the metabolism cannot be carried away and the osmosis in that tissue increases to such an extent under pressure that in spite of the open arteries in the experiments of Bier and in spite of the fact that the arteries are not completely patent in cases of thrombo-angiitis through osmotic pressure, blood is drawn into these parts. By closing the arteries as Bier has done and opening them, by closing the veins as he did, not allowing the blood to be carried off, he has, obviously, left a certain amount of wreckage in the tissue. He has increased the osmotic pressure in the tissue. Then, naturally, as a consequence, as soon as the arteries were opened again he got more blood into the extremity. I only offer that as a suggestion because it could probably be experimentally proved.*

**Dr. Irving Sherwood Wright** (closing): I would like to clarify one point as a result of Dr. Edwards' discussion regarding the use of iontophoresis in the treatment of varicose ulcers. We do not feel, as has been stated in our articles, that it is a treatment to take the place of varicose vein injections. There are a number of patients in our series who have a deep occlusive phlebitis or have had it in previous years, so that injection of the outer veins is impracticable and unsafe, and in some instances where it has been attempted an ulcer has appeared following the injection of the outer veins. In that type of case we feel that the use of iontophoresis is of definite value. There are also individuals with a subacute phlebitis and others with diabetes where the injection of the superficial veins, the value and the wisdom of it may be questioned. That, it seems to us, represents the great field of usefulness for treatment by iontophoresis.

* Note. — Above discussions include paper of Dr. B. C. Smith. — Ed.

# DIATHERMY IN CALCIUM DEPOSITS AROUND SUBACROMIAL BURSA AND SUPRASPINATUS TENDON *

B. S. TROEDSSON, M.D.

BRYN MAWR, PENNSYLVANIA

In 1923 Harris[1] recorded six cases of calcified subdeltoid bursitis which had received symptomatic relief by treatment with diathermy in 7 to 40 treatments. He did not at the time show that the calcium deposit actually disappeared. Two years later he[2] recorded one case in which x-ray pictures showed that the greater part of a calcium deposit had disappeared following treatment with diathermy. Mumford and Martin[3] cited in 1931 their experience with diathermy in the treatment of 14 cases of calcified deposits in subdeltoid bursitis and presented x-ray pictures in four cases showing the disappearance of the deposit. They stated that "all their patients became well by this conservative form of treatment and in all cases with a deposit shadow, the deposit either entirely disappeared or became much smaller and less dense in the roentgenogram. In none was surgery necessary. The average number of treatments was 21, given daily for the first two weeks and then twice a week."

Mumford and Martin reviewed extensively the literature on the subject and quoted the works of Codman, Carnett, Titus, Harris, Resnik, Granger, Bricker, Stern, Steindler, Moschcowitz, and Deering for ideas on etiology, pathology, symptomatology and therapy. Before the advent of diathermy,

* From the Department of Physical Therapy, Bryn Mawr Hospital.
* Read at the Sixteenth Annual Session of the American Congress of Physical Therapy, Cincinnati, Ohio, September 22, 1937.

operation was advised, but as there is no unanimity in regard to etiology, many different conservative procedures were advocated. Cooperman, Harris, Resnik, and Titus are quoted by Mumford as believing that the deposit could be dissipated under the influence of diathermy. Since 1931, many authors have testified to the value of this agent, with or without other physical therapeutic procedures. Among the authors may be mentioned Weisblum,[4] Hitzrot,[5] Rogers,[6] Nilssen,[7] Gwynne and Robb,[8] Kovács,[9] Echtman,[10] Polmer.[11]

While all these men report that they use diathermy in the treatment of calcium deposits around the shoulder joint and seem to believe that it is of value, there is no unanimity in regard to technic or in regard to the absolute specificity of diathermy. The size of the electrodes varies, the method of application varies, the frequency and the length of treatment vary. One author combines the diathermy with iodine ionization and claims it to be superior without presenting any control cases. Another uses ultraviolet in addition or adds massage, motion and exercise. No one has attempted to find the best technic, or has attempted to correlate the total number of hours of diathermy required to remove the deposit with the size and the density of the calcium deposit or with its duration. This paper must be considered an attempt to do this. To give a complete and definite answer will probably never be possible because of the many factors involved. One can only guess at the duration of the deposit as it is often present before symptoms manifest themselves. Only x-ray pictures will tell when the deposit has disappeared and they may have been taken long after the deposit has actually been dissipated, as symptoms are no guide, often ceasing before the deposit does. Only an idea of the size of the deposit can be gained from x-ray pictures as the third dimension is missing. The density of the deposit may vary depending upon how the picture is taken, and there are no standards of comparison. However, in order to make progress in this field these factors must be taken into consideration so that some constant can be obtained by which one can judge the efficacy of a new treatment or a departure from the old.

In our cases the deposits have been classified in regard to density into three groups. Group 1 is less dense in the x-ray picture than the head of the humerus through the medulla. Group 2 is as dense as the head, and group 3 is denser than the head. The deposits have also been classified in regard to size. In group 1 are those deposits presenting less than one-quarter of a square centimeter surface in the x-ray picture. A group 2 deposit has a surface of between one-quarter and one square centimeter. In group 3 deposits have a surface of more than one square centimeter. This classification serves a useful purpose, even though it leaves at times much to be desired in precision.

In order to evaluate the importance of rest in the disappearance of the deposits, this factor has also been classified. In the table under the column "Rest" 0 denotes that the arm was used for work, 1 that it was not used but had no support, 2 that it was supported in a sling, and 3 that it had absolute rest, either by the patient being hospitalized or staying in bed at home. Again this is no sharp classification as the patients generally increased their activities with the improvement in the symptoms, but for practical purposes it must be sufficient. To estimate the duration of the deposit is almost impossible, as has been said before, but it is my firm belief that many of the cases treated had had them for years, as suggested by their symptoms In case 13 (see table) it was possible to say that the deposit had been there for 6 years because it showed in an x-ray taken at that time and the symptoms had persisted ever since.

Our x-ray studies have been supervised by Dr. Ralph Bromer, roent-

Fig. 1

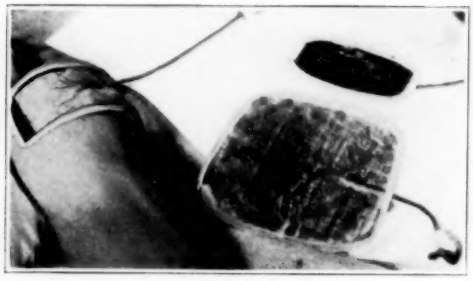

Fig. 2

Fig. 1. — Anterior-posterior technic, the appearance of the plates and the plates in position. Fig. 2. — Anterior plates held in place by sandbags and both plates connected to the machine.

genologist at Bryn Mawr Hospital, and I am greatly indebted to him for his unfailing cooperation and kind assistance. All examinations have been made with the arm in external and internal rotation and with a 40 cm. target-film distance. The original position showing the deposit was always duplicated as nearly as possible at subsequent examinations to make sure that the deposit was not hidden under the bone.

## Technic

A total of 30 cases of calcium deposits around the shoulder have been treated in a period of less than 3 years. In all of these the diagnosis was corroborated by x-ray examination. In 13 cases it was possible to trace the disappearance or the virtual disappearance of the deposit by means of repeated x-ray pictures during the treatment period, and these cases form the basis of this report. Four different conventional diathermy machines have been used. No allowance has been made for this as they are all believed to have similar effects. Two different technics have been employed, and when a patient was started on one he was carried through on that. The anterior-posterior technic (fig. 1) consisted of an "active" small pliable block tin electrode, 9x5 cms., placed over the anterior part of the shoulder in the following way: With the patient recumbent and the arm supported on a pillow or a folded blanket and rotated in, the electrode is moulded to the shoulder in such a way that the long upper border lies close to and parallel with the lateral margin of the acromial process. The lateral margin of the electrode reaches to the middle of the deltoid. This is held in place by sandbags (fig. 2). Posterior to the shoulder is placed an inactive electrode, measuring 13x12 cms., in such a way that the upper margin of the electrode is barely visible and the lateral margin is in a line with the lateral margin of the thorax. With this arrangement we believe that we attained a considerable degree of concentration of the current directly over the region of the bursa.

The lateral technic (fig. 3) utilizes the same plates but in a different manner. The small, active electrode is placed at the lower margin of the deltoid muscle and across the biceps and is held in place by a rubber bandage. The inactive electrode is placed close to the spine and with the upper margin visible. In both technics we have used only the amount of current required to cause a feeling of comfortable warmth underneath the active electrode. Generally this amounted to between 500-700 ma. The average

Fig. 3. — Lateral technic with the small plate held in place by a rubber bandage.

length of a treatment has been about 40 minutes. Some patients were treated twice a day, others only every other day.

Table 1 shows the results that were obtained. From this it appears that diathermy must be of definite value in dissolving the deposit or else there should not be such a marked difference between the two technics. The anterior-posterior technic with its concentration of the current over the bursal region is superior to the lateral technic as far as can be judged from the cases here presented. Rest does not seem to have any influence on the rate of absorption. On the other hand it seems safe to conclude that the number of hours of diathermy required for absorption increases with the size and the density of the deposit. What role the duration of the deposit plays has not been determined. Case 13 with x-ray evidence of 6 years duration was the most protracted of all, indicating that the longer the duration the more difficult the absorption.

TABLE 1. — *Calcium Deposits in the Subacromial Bursa and Around the Supraspinatus Tendon Removed With Conventional Diathermy.*

| Case | Technic | Size | Density | Hours of Diathermy | Rest | Number of Treatments | Time Period |
|---|---|---|---|---|---|---|---|
| 1m | A-P | 3 | 3 | 10 | 3 | 15 | 4½ weeks |
| 2f | A-P | 3 | 2 | 8½ | 2 | 17 | 4½ weeks |
| 3f | A-P | 3 | 2 | 17 | 2 | 25 | 5 weeks |
| 4m | A-P | 2 | 2 | 8 | 1 | 11 | 3 weeks |
| 5f | A-P | 2 | 2 | 17 | 0 | 25 | 8 weeks |
| 6f | A-P | 2 | 1 | 8 | 2 | 13 | 2 weeks |
| 7m | A-P | 2 | 1 | 7½ | 1 | 14 | 4 weeks |
| 8f | A-P | 2 | 1 | 8½ | 3 | 13 | 2½ weeks |
| 9f | A-P | 1 | 2 | 6½ | 2 | 10 | 3 weeks |
| 10f | A-P | 1 | 2 | 6½ | 1 | 10 | 6 weeks |
| 11m | Lat. | 3 | 3 | 29 | 3 | 41 | 9 weeks |
| 12m | Lat. | 3 | 3 | 36 | 3 | 48 | 6 weeks |
| 13f | Lat. | 2 | 2 | 45 | 2 | 60 | 11 weeks |

**Size**

| | |
|---|---|
| Surf. area of more than 1 sq. cm. | 3 |
| Surf. area of 1 sq. cm. — ¼ sq. cm. | 2 |
| Surf. area of less than 1 sq. cm. | 1 |

**Density**

| | |
|---|---|
| Denser than bone (see text) | 3 |
| Dense as bone | 2 |
| Less dense than bone | 1 |

**Rest**

| | |
|---|---|
| Absolute rest | 3 |
| Arm in sling | 2 |
| No support | 1 |
| Working | 0 |

## Conclusions

With the cooperation of the patients it was possible to follow by means of repeated x-ray pictures the disappearance of calcium deposits in the subacromial bursa and around the supraspinatus tendon in 13 cases out of 30

treated with conventional diathermy. Two different technics were employed. One is called the anterior and the other the lateral. In evaluating the results the size and the density of the deposit has been takn into consideration as has also the amount of rest that the extremity received.

Conventional diathermy is of definite value, the anterior-posterior technic being decidedly superior to the lateral. The total number of hours of diathermy required for dissolution of the deposit increases with its size and density. Rest does not appear to be a major factor in the dissolution of the deposit. What role the duration of the deposit plays has not been determined. In one case it was possible to say that the deposit had been present for 6 years; it was the most protracted of all.

## References

1. Harris, J. F.: The Treatment of Calcified Subdeltoid Bursitis by Diathermia, J. A. M. A. **82**:98 (July 14) 1923.

2. ————: Action of Diathermy in Calcified Subdeltoid Bursitis, J. A. M. A. **85**:1134 (Oct. 10) 1925.

3. Mumford, E. B., and Martin, Florence J.: Calcified Deposits in Subdeltoid Bursitis, J. A. M. A. **97**:690 (Sept. 5) 1931.

4. Weisblum, Maurice: The Treatment of Subacromial and Subdeltoid Bursitis, Arch. Phys. Therap., X-Ray, Rad. **14**:341 (June) 1933.

5. Hitzrot, James Morley: Surgical Diseases of the Shoulder Bursa, Ann. of Surg. **48**:273 (Aug.) 1933.

6. Rogers, Mark A.: A Study of One Hundred Cases of Subdeltoid Bursitis, J. Bone and Joint Surg. **16**:145 (Jan.) 1934.

7. Nilssen, Leon: Follow-up Examinations of Calcium Deposits in Region of Shoulder, Medicinsk Rev. **51**:67 (Oct.) 1934.

8. Gwynne, F. G., and Robb, Douglas: Calcarous Deposits in Supraspinatus Tendon and Subracromial Bursa. The Australian and New Zealand J. of Surg. **4**: 153 (Oct.) 1934.

9. Kovács, Richard: Electrotherapy and Light Therapy. Philadelphia, Lea & Febiger. Second Edition, 1935, p. 565.

10. Echtman, Joseph: Traumatic Subdeltoid Bursitis, New York S. J. Med. **36**: 503 (April) 1936.

11. Polmer, Nathan H.: Subdeltoid Bursitis. Its treatment by Physical Therapy, New Orleans M. & Surg. J. **87**:829 (June) 1935.

## Discussions

**Dr. John D. Currence** (New York): The work which Dr. Troedsson has done in his efforts to correlate the actual hours of diathermy necessary to remove calcium deposits, according to the size, density and duration of the deposit thus using as definite a standard as possible, is a departure from the usual reports on this work which seems to offer a great deal in establishing a definite prognosis. There is little doubt but that surgery will in the future be rarely necessary except in very advanced or neglected cases. With regard to the specificity of diathermy, it seems to me that its action in removing these deposits could better be evaluated on the basis of relative efficiency, inasmuch as deposits can be definitely removed using several other physical agents. But the evidence seems to bear out that the most rapid and efficient medium is either short wave or conventional contact electrode diathermy.

Following the technic outlined by Granger, using only chlorine ionization, in many cases the x-ray has demonstrated the disappearance of these deposits in 15 to 30 treatments. Using only mild hyperpyrexia in an under water therapy tank with hydro-massage to the shoulder followed by passive and active underwater exercise, similar disappearance of the deposits and restoration of function has taken place. My conclusion is that the problem is clearly one of evaluating the relative efficiency of diathermy over other physical methods rather than any question of possible specificity, and I feel that an effort to analyze the relative efficiency of all agents would be commendable.

Without such a desirable scale upon which to more accurately form conclusions, we are now treating most of these cases with short wave therapy, followed by underwater massage and exercise during a mild hyperpyrexia of 100 to 101 degrees F. mouth temperature; and occasionally in severe or resistant cases we use chlorine ionization after the short wave radiation and before the underwater therapy.

**Dr. Nelson Morris** (Toledo): Except for the x-ray, shoulder cases with deposits can not be distinguished from those without deposits. Symptomatically and clinically they are identical, whether they are seen before, during or after relief from

symptoms. Then how much do deposits matter? Are the cases treated to the disappearance of the shadow much less apt to have recurrences of symptoms than are those merely brought to an apparently lasting relief? Perhaps Dr. Troedsson already has the answer; if not, he has at least made an approach to it by obtaining a group of patients conservatively relieved of the deposits who may be compared with those not so relieved.

The importance of the deposits in these cases has mostly been assumed; likewise most clinicians have assumed that the spurs of hypertrophic arthritis are important. Both the deposits and the spurs are very commonly found unrelated to symptoms. Both of these are degenerative changes associated with the passing of youth and the beginning of senescence. When symptoms are found along with these roentgenologically demonstrable changes, the symptoms are those that may be found in the absence of these changes. The one etiologic factor to which these symptoms can most uniformly be related is trauma. These shoulder cases are practically all right-sided because most people are right-handed. Likewise the symptoms of hypertrophic arthritis are with practical uniformity to be explained as traumatic. No practical importance attaches to a deposit or spur except as it may by size or roughness interfere with motion or contribute to trauma. In the absence of demonstrable hard-tissue changes, the diagnosis of similar cases is apt to be fibrositis. One wonders if this diagnosis is less adequate because of deposit or spur.

To attempt correctly to define the symptom-producing values of these degenerative processes is by no means to belittle their importance or to detract from the excellent work which Dr. Troedsson has done in causing their disappearance. Few revelations would interest us much more than to learn how to prevent the formation of these deposits, of bony spurs and of arterial hardening. Blood chemistry, vitamin D and parathyroid studies have thus far failed to help us. If we know how to make these deposits disappear, perhaps we can learn why they appear.

**Dr. Norman E. Titus** (New York): Dr. Troedsson has very interestingly suggested a classification of degrees of calcification that have resulted from subdeltoid bursitis. This calcification is always between the bursa and the supraspinatus tendon. Infrequently it extends around the wall of the bursa, but orthopedic surgeons never have reported finding actual calcium in the bursa fluid. Although the number of cases reported is small, this proposed classification is interesting. To my mind, this is the only contribution of this paper.

I make the above statement because I wish to criticize most emphatically Dr. Troedsson's technic in administering diathermy in this condition. As illustrated by him, it is impossible to have any effect of diathermy in the region of the subdeltoid bursa. The current from the electrode applied to the arm will leave the upper edge of the electrode by the posterior-superior point and go along under the skin in the blood vessels to the other electrode placed on the patient's back. No one can make the current take any other course with the electrodes applied in that manner.

In 1925 I published and demonstrated a method of applying diathermy directly to the subdeltoid bursa and named this technic "grounded autocondensation." The patient is placed upon an autocondensation pad, which is connected with one terminal of the machine, and holds a handle connected with the other terminal. The machine is then turned on, registering a current flow of between 500 and 700 milliamperes. The operator then places one or more fingers directly over the bursa and the current in the patient is grounded around the dielectric (autocondensation pad). In this manner, the current in the patient is deliberately abstracted from the patient's body through the exact region of the bursa and is therefore only effective in this locality. It has been proven experimentally that the current flows through the operator to the ground. Of course, this dose of high frequency current is rather large for such a small area and if a metal electrode is applied, as has been suggested by some improvers of this technic, the amount of current suggested would certainly burn the patient. The cross section of the operator's finger or fingers being the smallest in the circuit, causes the greatest density of current in these fingers. Consequently, the operator feels the greatest amount of heat and, of course, will not burn his fingers and therefore continuously replaces one finger by another during the ten minutes of treatment. This is the only technic whereby effective diathermy can be actually applied to the subdeltoid bursa unless a cuff electrode is placed on the operator's arm and another electrode is placed at a distance from the shoulder on the patient's back.

The advocation of incorrect technic detracts from the value of Dr. Troedsson's paper and I feel in an experience of over 1,300 cases, I am in a position to question his technic.

It is only correct to state that treating subdeltoid accumulations of calcium due to chronic inflammation of the bursa with diathermy alone is not rational physical therapy. As I have stated many times, any one who applies "diathermy with a prayer" that it will do good, is not treating his patient to the fullest extent of his ability. In all cases, except a few pelvic conditions, the application of diathermy must be followed by mechanical effect as achieved by the static or sinusoidal current. In my large experience in the treatment of these conditions, I feel that any form of heat is merely a preparation of the part so that the application of static electricity will become more effective. I also feel that the speed with which my many cases have recovered has

been due to the effect of static electricity especially and the diathermy, even though correctly given, has merely been a preliminary procedure in the general treatment.

**Dr. B. S. Troedsson** (closing): Dr. Currence brings up a point that is well worth stressing. He uses a different method of treating these cases and wishes that an effort be made to compare the various methods. With the classification of the deposits we can in the future attempt to do this and may ultimately be able to cure these patients in one or two treatments instead of the many required at present.

In answer to Dr. Morris' question I can state that so far I have had no recurrence of either symptoms or deposit when the latter was once removed. In only symptomatically cured patients there was often a recurrence of symptoms until the deposit had been completely removed. It may also interest Dr. Morris to know that many of my cases were referred with a diagnosis of neuritis, fibrositis, or arthritis and when treated for that obtained little or no relief or got worse. With a corrected diagnosis and changed treatment relief was rapidly obtained. The role of the calcium metabolism in these cases is of extreme interest but is insufficiently known at present, as stated by Dr. Morris.

Dr. Titus takes for granted that these deposits are caused by a subdeltoid bursitis. In my opinion the calcium deposits are rather the cause of the bursitis than the result. Only rarely is a deposit found within the bursal sac as stated by Willis C. Campbell. Codman and Wright think that calcified deposits in the supraspinatus tendon are due to minor injuries of the tendon. It is certain that many patients have large calcifications without any symptoms of bursitis, and then there is a sudden flare up. T. K. Richards reported in 1931 two cases of acute bursitis with calcium deposits. Following the administration of iron cacodylate the symptoms disappeared but there was no lessening of the calcium deposit as shown by x-ray follow-up. Coupled with my own observations this makes me unwilling to accept any work in this field unless substantiated by x-ray pictures, no matter how many cases are reported. It seems a waste of words to criticize my technic of electrode application to the arm, the lateral technic. The figures show definitely that when it is used it is inferior to the anterior-posterior application. I have tried Dr. Titus' technic of applying diathermy by grounded autocondensation and have found it unsatisfactory for my purposes. To add sinusoidal or static current would in a work of this kind only introduce another variable and would detract from its scientific value. My purpose has been to set a definite standard. With my classification and the use of only one modality I am at liberty to try either the method of Dr. Currence or Dr. Titus and can compare results scientifically.

**Closing Date for Registration of Junior Physical Therapy Technicians**

After January 1, 1940, applications will no longer be accepted for Junior Physical Therapy Technicians. Information regarding registration under this classification may be obtained by writing to the Registrar, American Registry of Physical Therapy Technicians, 30 North Michigan Avenue, Chicago, Illinois.

# ARCHIVES of PHYSICAL THERAPY

**OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY**

**Editor: DISRAELI KOBAK, M.D., CHICAGO**



**EDITORIAL BOARD**

**Medicine** — WILLIAM BIERMAN, M.D., *New York;* JOHN D. CURRENCE, M.D., *New York;* J. C. ELSOM, M.D., *Madison, Wis.;* F. H. EWERHARDT, M.D., *St. Louis;* JOHN SEVERY HIBBEN, M.D., *Pasadena;* FRANK H. KRUSEN, M.D., *Rochester, Minn.;* EDGAR MAYER, M.D., *Saranac Lake;* MARY ARNOLD SNOW, M.D., *New York;* NORMAN E. TITUS, M.D., *New York;* JAMES WILTSIE, M.D., *Binghamton, N. Y.;* HEINRICH WOLF, M.D., *New York.*

**Surgery** — GUSTAVUS M. BLECH, M.D., *Chicago;* JOHN S. COULTER, M.D., *Chicago;* GUSTAV KOLISCHER, M.D., *Chicago;* WM. H. SCHMIDT, M.D., *Philadelphia;* F. H. WALKE, M.D., *Shreveport, La.;* GRANT E. WARD, M.D., *Baltimore.*

**Eye, Ear, Nose and Throat** — A. R. HOLLENDER M.D., *Chicago;* O. B. NUGENT, M.D., *Chicago;* F. L. WAHRER, M.D., *Marshalltown, Ia.*

**X-Ray and Radium** — HARRY H. BOWING, M.D., *Rochester, Minn.;* R. W. FOUTS, M.D., *Omaha;* R. E. FRICKE, M.D., *Rochester, Minn.;* IRA I. KAPLAN, M.D., *New York;* A. F. TYLER, M.D., *Omaha.*

**Biophysics** — ALBERT BACHEM, Ph.D., *Chicago.*

**Biochemistry and Nutrition** — VICTOR E. LEVINE, Ph.D., M.D., *Omaha.*

**Foreign Collaborators** — OSCAR BERNHARD, M.D., *St. Moritz;* H. BORDIER, M.D., *Lyons,* ELKIN P. CUMBERBATCH, M.A., M.B., (Oxon) M.R.C.D., *London;* A. R. FRIEL, M.A., M.D., (Univ. Dub.), F.R.C.S.I., *London;* SIR HENRY GAUVAIN, M.D., M.Ch., *Alton, Eng.;* F. HOWARD HUMPHRIS, M.D., (Brux.), F.R.C.P., (Edin.), D.M.R. and E. (Camb.); MOREL KAHN, M.D., *Paris;* JOSEF KOWARSCHIK, M.D., *Vienna;* FRANZ NAGELSCHMIDT, M.D., *Manchester, Eng.;* A. ROLLIER, M.D., *Leysin;* CARL SONNE, M.D., *Copenhagen;* ALBERT E. STEIN, M.D., *Wiesbaden.*


# EDITORIALS

## SHORT WAVE DIATHERMY IN CARDIOVASCULAR DISEASE

The past few decades witnessed revolutionary contributions in the study of cardiovascular disease, both from its diagnostic and therapeutic aspects. Increasing physiologic information introduced a more balanced impression of the various factors responsible in heart failure and vosomotor disturbance. Of the men preeminent for labors that stimulated this interest all occupy the position of pioneers responsible for the present renaissance in cardiology. Gaskell introduced the fundamental concept in cardiac rhythm. MacKenzie presented the classification and pointed out the significance of the different clinical disturbances of cardiac rhythm. Lewis' interpretation of the electrodynamic phase of heart action introduced the most precise expression of the various physiologic steps that complete the cardiac cycle. By means of the electrocardiogram we now have an exact objective method of evaluating muscular function of the heart comparable to the stethoscope for valvular lesions — a visualization of the central mechanism in action rather than mass in static position. No less epochal were the innovations of d'Arsonval whose studies in electrophysiology with his string galvanometer and high frequency current were responsible for a new orientation in diagnostic cardiology and a method of therapy based on the deep heating, vasodilating and antispasmotic effects of the above mentioned current.

In view of the limited and non-specific remedials and actuarial statistics pointing out the precarious position of individuals suffering from coronary arterial and angina pectoris disease, search for reliable adjuvants suggested the study of this dominant vasodilating and heating property of conventional and short wave diathermy for certain heart lesions. Clinical reports of encouraging percentages of symptomatic relief obtained by ordinary diathermy in precordial, substernal pains and in anginal paroxysms (Nagelschmidt, Bordier, Kowarschik, Cumberbatch) proved an incentive for investigation un-

der more exact objective and laboratory conditions. In 1928, Kobak[1] observed improvement in cardiac arrhythmias by diathermic comparative study with electrocardiogram controls. In 1933, Hyman[2] reported beneficial results in a group of 87 patients suffering from chronic anginal attacks and coronary thrombosis together with electrodynamic deviations of the terminal ventricular complex. His explanation follows the general concept of the clinical action of diathermotherapy. He asserted:

> In the vast majority of instances, symptomatic relief was obtained even when standard methods of drug therapy had failed to produce any lasting benefits. Simultaneously with the clinical improvement in the patient there has been a change in the electrocardiograms; the previous negativity of the T-waves is first lessened and then a normal positive deflection is obtained. The apparent explanation of the return to a normal electrodynamic status of the heart lies in the fact that exposure to diathermic current increases blood flow to an impoverished myocardium and that with a disappearance of the partial anoxemia, the myocardium tends to return to its former normal physiological mechanism.

Accordingly, there is now evidence more than presumptive to indicate subjective and objective effects following transthoracic diathermy. Whether this effect is transitory or far lasting is for the moment of lesser importance than the established proof of its regulating influence on the arrhythmic state associated with extra-systole and auricular fibrillation. To this must also be added the ability to revert the negative phase of the T-wave in the electrocardiogram to a positive or normal deflection which follows the clinical improvements seen in chronic coronary thrombosis and angina pectoris. Despite these findings, recognition of the efficacy of high frequency in cardiology has been held *sub judice* because the gravity of this disease required the most unequivocal substantiation. Predominant reliance on subjective findings, the limited clinical data at hand and the inadequate physiologic method heretofore utilized, formed a mixed background requiring additional confirmation under more critical supervision. Moreover, with the recent replacement of ordinary by short wave diathermy, the simplification of technic, confusion as to wattage and wavelengths, dosage regulation and the like, have made it necessary to review this problem under a different setting. This too has in a manner already been accomplished, but to that degree only which still requires the separation of rule of thumb impressions from proved facts.

Kowarschik[3] was among the earliest to point out the pain relieving action of short waves in angina pectoris. He came to the conclusion that unless pain was relieved within the first ten treatments, further efforts were useless. This clinical observation was supported by the objective findings of Siegen and Hempel,[4] who observed a series of 220 cases of angina pectoris and coronary sclerosis treated by short wave, carbon dioxide baths and glucose injection. The subjective improvement following irradiation was supported by electrocardiographic tracings which indicated the change of T-wave from its negative to its positive deflection. It was pointed out that on rare occasions untoward spasmodic reactions would follow that had to be controlled by papaverin. Accordingly, treatment must be supervised by properly oriented physicians both to prevent painful exaccerbations and to insure proper medication when need arises. Favorable results have also been reported by Saidman and Meyer,[5] Rechou,[6] and Weissenberg,[7] the majority of whom have insisted on mild irradiations in contrast to the heavy dosages advocated by the German school. In their opinion heavy dosage tends to produce deep heating of the heart, which in turn increases the activity of the muscle and stimulates its vagotonic components; while with minimal or moderate dosages there results a lowering of the sympathicotonic

influence. This is in accord with the experimental findings of Liebesny[8] who observed a sinusal bradycardiac effect in the irradiated heart of a frog, which indicated an elective action of short waves on the sympathetic system.

Undoubtedly the most impressive review of the influence of short waves on cardiovascular pathologic process is that of Laubry, Walser and Meyer[9] published elsewhere in this issue. While it by no means satisfies all the postulates of a scientific contribution; that is to say, a parallel study under rigid controls consecutive in time and in number of patients, the data incorporated are nevertheless so comprehensive and analytical to appeal to critical readers as the most conservative evaluation under the circumstance. The omission of generalizations and the correlation of laboratory evidence to confirm the clinical benefits obtained by short wave diathermy in angina pectoris and high blood pressure, lends credence to the conservative explanation of the effectiveness of the physical method and of the influence on the physiologic mechanism.

## References

1. Kobak, Disraeli: Electrocardiogram Studies of Cardiac Arrhythmia and Angina Pectoris by Diathermy, Personal data, 1928.

2. Hyman, A. S.: Electrodiographic Control of Diathermy in Angina Pectoris and Coronary Artery Disease, Arch. Phys. Therap., X-Ray, Rad. **14**:270 (May) 1933.

3. Kowarschik, J.: Kurzwellentherapie, Vienna, Julius Springer, 1936.

4. Siegen, H., and Hempel, K.: Kurzwellenbehandlung im Badeort bei Angina pectoris vera und verwandten Krankheitszuständen, Fortschr. d. Ther. **12**:31 (Jan.) 1936.

5. Saidman, J., and Meyer, J.: Les ondes courtes en thérapeutique, Paris, G. Doin & Cie, 1936.

6. Réchou: Les ondes courtes en mèdecine, J. radiol. et d'electrol. **17**:481 (Sept.) 1933.

7. Weissenberg, E.: Beeinflussbarkeit angio-trophoneurotischer Symptomen durch Kurzwellen, Wien. klin. Wchnschr. **47**:302 (March) 1934.

8. Liebesny, P.: Kurz und Ultrakurzwellen, Wien, Urban & Schwarzenberg, 1935.

9. Laubry, Charles; Walser, J., and Meyer, Jean: Pyretotherapy in Cardiovascular Diseases, Arch. Phys. Therap. **19**:144 (March) 1938.

---

## INTENSIVE INSTRUCTION COURSE TO PRECEDE SEVENTEENTH ANNUAL SESSION

Plans are under way for an intensive instruction course in physical therapy to precede the annual session which will be held at the Palmer House, Chicago, in September. The exact dates during which the course will be conducted are September 7, 8, 9 and 10. The program calls for didactic and clinical lectures, round table conferences, clinics and technical demonstrations.

While the time is somewhat far off, the committee has already begun to enroll applicants. It is therefore suggested that those who plan to participate in this intensive study program make application immediately. Physicians and technicians properly vouched for, are eligible, but inasmuch as this work is being given primarily for doctors of medicine, only a limited number of technicians can be accepted.

The faculty will be comprised of men and women now actively engaged in teaching or research. Prominent clinicians in all the specialties have been secured and more than twenty will make up the list. The fundamentals will be reviewed, but emphasis will be laid on the newer developments. Technical demonstrations will be provided for, with adequate opportunity for informal discussions in the round table conferences. Hospital clinics for the demonstration of electrosurgery, short wave diathermy, hydrotherapy, fever therapy and other procedures have been arranged. The physical therapy of arthritis, anterior poliomyelitis, industrial

injuries, fractures, gynecological and genito urinary conditions, etc., will be thoroughly covered.

Fellows of the Congress will be admitted for a fee of $20; for others the tuition charge is $25. Please do not send check immediately, but request application blank first. Further instructions regarding registration will be furnished each applicant by mail.

Since the demand for this course will undoubtedly be far in excess of the restricted number to be admitted, the committee strongly urges immediate requests for application blanks. Early registrants whose qualifications are passed upon by the committee will receive preference in the order of acceptance.

This will be the outstanding refresher course in physical therapy. You cannot afford to miss it. Write today for application to American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago.

# CORRESPONDENCE

## Dosage Measurement in Short Wave Diathermy

*To the Editor*:—In the October, 1937, issue of the ARCHIVES appeared an article "Dosimetry and Short Wave Therapy," by Dr. Mittelmann. Because of the importance of this problem, which you recognized by editorial comment, I have felt that it might be worth while to state some of the objections to the procedure therein described. This seems to me to be of particular importance since the impression seems to have gained ground among many medical men interested in short wave therapy that the dosage problem is now solved.

My objections to the method are not based upon any technical consideration of the circuit described. This is a subject by itself and entering into it would hardly be in place here. We shall assume for the purpose of this discussion that the technical requirements for power measurements have been completely met and that the device proposed indicates correctly the rate of delivery of energy to the patient.

To clarify our ideas on the subject, let us consider the corresponding problem in conventional diathermy. In that field no one ever seems to have been troubled by the lack of a wattmeter. The reason for this is fairly obvious. In virtually all of the applications of conventional diathermy the maximum concentration of current occurs at the electrode skin interface and the distribution of the current density over the surface of the electrode is reasonably uniform. Thus, the maximum concentration of power is directly proportional to the square of the maximum current density; the latter is equal to the current divided by the area of the smaller electrode. Furthermore, the power absorption for a unit of current density at the wavelengths of conventional diathermy is relatively independent of wavelength, because the displacement current which is an important element with short wave is, in this case, practically nil. Note that what we measure in diathermy in its practical application is the maximum *concentration* of power or at least a quantity upon which this directly depends. It is this quantity which determines the initial rate of elevation of temperature at the point of most rapid increase. A prediction of the subsequent rise in temperature of the various portions of tissue in the path of the current depends also upon physiologic factors which are so involved that no reasonably complete solution is as yet available.

This quantity, which in conventional diathermy is measured by the maximum current density, is the quantity the measurement of which is of great importance. A measurement of power would help us not at all, because such information would yield the maximum power concentration only after extended calculations involving the distribution of currents throughout the volume treated. In conventional diathermy, therefore, power measurement is unnecessary and in fact of little value.

Why should the situation be different with the short wave current? A completely correct measurement of power could give us no information as to the maximum *concentration* of power unless we knew the distribution of power throughout the volume through which the current flows. Such information is even more difficult to obtain than information concerning the distribution of current density over the skin surface. With air space condenser electrodes, the only one which I am considering, there does exist at least an approximate equivalence between a contact electrode of suitable size and the condenser elec-

trode. An estimate of the size of this virtual electrode together with a measurement of the current flowing through the patient and the specific absorption of the tissues at the site of heating would permit a calculation of a quantity similar to the one which we use in practice in conventional diathermy.

It is unquestionably the case that the measurements demanded in the end of the last paragraph are impossible in practice at the present time, except in very special cases. Neither are the measurements necessary for proper evaluation of a wattmeter indication possible at the present time. We are thus forced to the conclusion that we have not yet a solution to the dosage problem in short wave therapy.

As a matter of practical application it is probably sufficient to try the proposed treatment upon a normal individual whose judgment as to temperature is good, obtaining in this way the proper setting of the machine for the treatment, and thus to proceed confidently with the treatment of others. The subjective method of "dosimetry" is, it seems to me, in spite of the development of the wattmeter, still the only available method.

In no way do I wish to detract from the importance and ingeniousness of Mittelmann's suggestion, but I think we must be careful not to become overly optimistic, lest we assume a problem to be solved when, in fact, much more work must be done. The dosage problem in short wave may have a practical solution as satisfactory as that of conventional diathermy, but it has not yet been proposed.

Myron M. Schwarzschild,
Physicist,
Beth Israel Hospital,
New York City.

*Note:—We have submitted the above correspondence to several American and European authorities, whose replies follow.—ED.*

## From Primar Arzt, Dr. J. Kowarschik, Vienna

*To the Editor:*—The dosage of short wave therapy in the past has suffered shipwreck on account of two difficulties. To begin with it is not possible absolutely to measure with the aid of a simple ammeter currents of such high frequency as is possessed by the short waves. Even if it were possible to determine the intensity of a current yielded by a short wave generator in amperes, it would not be of much use to us in therapy because only a part of the energy produced by the apparatus is taken up by the patient and utilized for treatment. How much of the total current is exploited therapeutically varies according to the external conditions.

If we had the possibility to measure that part of the current which flows through the patient, we could be completely satisfied, for we would then have a measure similar to that of ordinary diathermy. In this respect Schwarzschild is right; unfortunately, however, he does not state how he measures the current utilized therapeutically. On the other hand Mittelmann has shown how one can measure directly in watts the electric energy taken up by the body of the patient and, what is most important, he has technically solved this problem. Personal experiments with Mittelmann's dosimeter have proved that for therapeutic purposes the measurement is adequately exact.

If one proposes the question whether it is more purposive to measure the wattage taken up by the body or the current flowing through the patient, there can be no doubt that the former is preferable for the physician. The amount of warmth taken on and measured in calories and the corresponding rise in temperature, are directly proportional to the number of watts, as they are increased in a simple and direct ratio. The situation is different as regards the intensity of the current but not in a direct relation, because this takes place not in a simple, direct but in a complex ratio expressed in squares.

Naturally one cannot compute from the number of watts the rise in temperature, for this depends not only on the number of calories taken up, but from the bodily mass through which these calories are distributed. This bodily mass in short wave therapy is mainly determined by the size and distance of the electrodes by which this current intensity is applied. One ampere will produce with an electrode of 100 cm.$^2$ an essentially more intense heating than with an electrode of 300 cm.$^2$ Here, too, the heated mass extends with the size of the electrodes. In this respect the same conditions exist in short wave therapy as in ordinary diathermy.

Dr. Josef Kowarschik,
Kaiser Jubiläum Hospital.

## From Engineer Eugen Picker, Vienna

*To the Editor:*—Referring to Schwarzschild's criticism of Mittelmann's communication on short wave dosimetry, the former starts a discussion whether it is correct to take the power delivered to the patient as the factor to be measured. He proposes in analogy to conventional diathermy to measure the current density at the skin but admits at the same time that this is not possible with our present means except in some special cases. I do not think it very useful to compare a method which we do not yet possess with one that works well in any form of treatment, as airspace condenser electrodes, unipolar treatment, coil, and the like. The measurement of the current density has the further disadvantage that the results obtained at different wavelengths cannot be compared directly, as with increasing frequency the displacement current forms an increasing part of the total measured current while the power absorbed is a factor which determines, independently of frequency, the rise of temperature.

For therapeutic purposes it is obvious that the measurement of the power together with the description of the size and situation of the electrodes employed facilitates duplication of a cer-

tain treatment at any time and with any apparatus. This is the great contribution by Mittelmann's device obviating the subjective methods used until now. From the point of view of scientific research, as Schwarzschild points out, we not only want to know the total power but also its distribution within the body. It may be mentioned that investigations in this direction have been carried out by Mittelmann and myself, and that Mittelmann's device has proved a useful instrument also for this research.

EUGEN PICKER,
University Clinic for Nervous Diseases.

## From Egbert von Lepel, Engineer, New York

*To the Editor*:—I read with interest the article in the October, 1937, issue of the ARCHIVES referring to dosimetry and short wave therapy by Mittelmann, and I also studied the standpoint which Mr. Myron M. Schwarzschild takes with regard to this matter in his communication. I fully share Mr. Schwarzschild's opinion with regard to the very limited usefulness of the dosimeter proposed by Mittelmann. I do not think that this instrument will be of great help to medical science with regard to establishing correct dosage in a given treatment, and I still much less believe that this instrument will be of any real value in short wave treatments. I feel that encouragement should be given for the development of practical methods to determine the field concentration or the heat produced in any given body area under treatment, in order to enable the physician to determine dosage, but the Mittelmann method certainly does not lend itself for such determination because it does not take into account the energy consumed per cubic centimeter, which is what really counts in local treatment.

EGBERT VON LEPEL.

## From Dr. H. Weisz, Vienna

*To the Editor*:—I beg to refer to Mittelmann's article on short wave dosimetry and to Schwarzschild's remarks on that important question.

What is demanded from any method of dosimetry is, that it may enable us to reproduce a form of treatment found to be the best in a certain case with any apparatus. It will then be possible by intensive research to find exact guidance for the treatment of the different diseases, so that every physician will be enabled to treat with short waves according to those rules.

We have found Mittelmann's device a satisfactory method of dosimetry for short wave diathermy by measuring the density of the current passing through the skin. Physicists are agreed that the exact measurement of the current passing the body is not possible at the frequencies used in short wave therapy. Therefore we have to measure another responsible factor — at a certain disposition of the electrodes — for the rise of temperature within the tissues. Mittelmann's instrument measuring the power absorbed by the patient fulfills this demand. In addition, the measurement of power yields data independent of the wavelength employed. It should be recalled that the current is composed of two parts; the ohmic component, which causes the development of heat, and the capacitive component, which is supposed to be of little if any efficiency. As the latter increases inversely with the shortness of the waves, the statement of a certain current would mean different heating at different wavelengths.

In consequence of all this I am convinced that Mittelmann's dosimeter is until now the best available method, and that it is an important step forward in short wave therapy.

H. WEISZ, PH.D., M.D.,
Vienna General Polyclinic,
University of Vienna.

## From Engineers Myron Drachman and George Mantell, New York

*To the Editor*:—We have read with great interest Dr. Mittelmann's article on "Dosimetry and Short Wave Therapy" in the October issue of the ARCHIVES. With the object of procuring a more complete exposition of the method than can be obtained from the above mentioned paper we provided ourselves with a translation of Mittelmann's original article which gave a more detailed analysis of the principles involved.

The subject of dosimetry in short wave therapy is very important. The difficulty of measurement has often been advanced as a serious drawback to the scientific use of short or ultrashort waves for heating tissue.

A careful study of the Mittelmann method convinces us of its technical accuracy and we feel that it constitutes a forward step in the application of electrical principles to clinical research in medicine. The therapeutic application of this method is difficult and will doubtless preclude its use in routine therapy. We feel, therefore, that a simpler and more direct measuring method is indicated. A knowledge of the total power absorbed by the patient does not give us all the data we desire. Simplifying the method of measurement is not the all important consideration. The distribution of this energy through the body is probably of far greater technical importance. The "total power" measurement is the only quantity the Mittelmann wattmeter can determine.

Schwarzschild analyzes the problem as a measurement of "the distribution of power throughout the volume through which the current flows." He also makes comparisons with conventional diathermy and arrives at the conclusion that the patient's subjective sensation is the best method of dosimetry.

We feel that neither x-radiation nor diathermy dosage can be considered by the same criteria to which ultra-high frequencies are subjected. In the two first mentioned forms, the total energy is admitted through a clearly defined window and the unit density is the ratio of total energy to

the area of the window. This fact eliminates one variable in the equation of energy transfer and greatly simplifies the measurement of its unit value by the limitations of skin tolerance. The comparative freedom of the application of ultra-high frequency currents from this type of limitation is a most valuable attribute.

In the application of conventional diathermy the operator measures the current in milliamperes flowing through the electrode, thereby determining the current density over the surface of the electrode. This is a very poor indication (although an important aid) as to the maximum tolerance of the patient. As an example: when using small electrodes of about 4x5 in. or 20 sq. in. in cross sectional area, posteriorly and anteriorly through the chest, the operator could easily apply 50 ma. per square inch of electrode or a total of 1,000 ma. When the size of these electrodes is increased to 12x12 in. or a total of 144 sq. inches, no operator would attempt to pass 50 ma. per sq. in. of electrode, or a total of 7,200 ma. through these larger electrodes. The actual energy that would be passed would then be about 7 times the former. The heat generated being a function of the square of the current and also directly proportioned to the resistance, which in this case is reduced in the same proportion that the cross sectional area is increased. Although the dosage density in milliamperes per sq. in. of the electrode is not increased, the patient could not tolerate this tremendous increase in *total* wattage. This excessive energy would produce considerable heating and lead to very bad burns. Therefore the technician was more or less guided purely by the subjective symptoms and also his general knowledge of technic. Dosage density, as measured in milliamperes per sq. in. of electrode is not an accurate guide to be relied upon completely. The maximum heat generated (actually a function of the energy absorbed in watts) in any area and the ability of the patient to dissipate this heat was the determining factor as to dosage control in diathermy. This rule also holds for short wave therapy. The measurement of ma. which is a function of dosage in watts in diathermy treatments permitted physicians to determine typical energies for the treatment of various conditions.

Since we are primarily concerned with the creation of heat in the tissues, as evidenced by the highest temperature achieved and the temperature gradient in all directions, we must study "the distribution of power throughout the volume" affected. It is this important point that demands a thorough study for successful dosage control. It is generally understood that the measurement of the total ultra-high frequency power applied to a portion of the body is not a complete guide to dosage since (especially in the ultrashort wave air-spaced application) the energy does not enter the body through a window of exact demarcation. Neither is the energy concentration of relatively uniform value, as in diathermy, where skin resistance limits the conductive currents to fifty (50) or sixty (60) milliamperes per square inch of small size electrode. A strict mathematical analysis of the physical principles governing the generation of heat in a human body by a field of high frequency energy would involve a large group of complex variables and would be difficult to calculate.

Lacking this complete solution it will probably be found sufficient for the immediate future to set up arbitrary standards of application for each of the customary methods of treatment applied to average patients. In any specific set-up under such conditions, a knowledge of the total power being absorbed by the patient would facilitate reproduction of treatment.

While far from final perfection, the Mittelmann method is at least a large step beyond the present custom of exclusive dependence upon subjective sensations of the patient. This method of measurement should further permit us to arrive at a systematic tabulation of results which can serve as a basis for statistical summaries from which empirical coefficients can be derived.

This leads us to the further conclusion that Mittelmann's method may then be made to act as a link between energy supplied, energy absorbed, and temperature created. It may further help to standardize machine outputs from the viewpoint of physiologic dosage units and may then also help to settle the wavelength controversy.

A knowledge of the total energy absorbed by the patient, the size of treatment electrodes used, the skin electrode distance, the pathology involved and the anatomic structure of the area being treated, will most certainly permit us to determine the maximum energy to be used per given size of electrode, and also to duplicate technic. The use of an ammeter in the patient's circuit of a short wave machine is far from a relative indication of dosage, as we must contend with displacement currents and radiation of energy, which do not produce any heating effect whatsoever in the patient's circuit, but serve to increase the ammeter reading.

MYRON DRACHMAN,
GEORGE MANTELL.

## From Dr. Eugen Mittelmann, Vienna

*To the Editor*:—It was with great interest that I read Mr. Schwarzschild's communication. As he points out, there is a certain analogy between diathermy and short wave therapy. No doubt in both cases we have as the principal factor the heat losses due to Joulé's effect, but beyond this analogy there is an essential difference between the two methods. Diathermy uses contact electrodes, the limit of maximum power (or maximum current density) being given by the maximum thermal load which can be applied to the surface of the body. Under such conditions it is, of course, sufficient to know the magnitude of the current flowing through the electrodes or the current density per surface unit. Further, in the case of ordinary diathermy they are the conductive paths that absorb power, the amount of this latter actually corresponding with ade-

quate accuracy to the square of the measured current.

In the case of short wave therapy we have the advantage of the possibility of absorbing power in the interior of the body without thermal overloading of the surface. The admissible maximum power does not any more depend on the current distribution over the surface of the body. It is this physical fact that forced us to search for a method which should enable us to integrate the total power dissipated in the body. By using air spaced electrodes it is by no physical means possible to measure the current passing through the body alone, as even the current measured at the very base of the electrodes will always contain a part due to the current radiated in space. Indeed, if it would be possible to do so, the current density of the surface of the body would never indicate the current distribution and therefore the power dissipated in the interior. This is due to the fact that the human body, from an electrical point of view, is by no means homogeneous.

Apart from this we know that current and current distribution greatly vary with frequency. We easily recognize that only a correct measurement of the absorbed power gives us a common and independent basis of comparison.

E. MITTELMANN, PH.D.

# SCIENCE, NEWS, COMMENTS

## Meetings of Physical Therapy Organizations

In this permanent column will be published information about meetings, election of officers, etc., of physical therapy organizations. New data should be sent promptly to the office of the Secretary, 1100 Park Avenue, New York.

*American Congress of Physical Therapy;* Palmer House, Chicago; September 12th to 15th; Dr. Richard Kovács, 1100 Park Avenue, New York, Secretary.

---

*Eastern Section, American Congress of Physical Therapy,* under auspices of New York Physical Therapy Society, and the Pennsylvania Physical Therapy Association, Wednesday, April 13, 1938, Mount Sinai Hospital, New York; Dr. Richard Kovács, Secretary, 1100 Park Avenue, New York. (See announcement elsewhere, this tissue.)

---

*Physical Therapy Session;* New York State Medical Society, New York City, May 11th. Madge C. L. McGuinness, M.D., Chairman; Harold J. Harris, M.D., Westport, N. Y., Secretary.

---

*Western Section of the American Congress of Physical Therapy and Pacific Physical Therapy Association,* 6th annual session, June 10 and 11, 1938, Los Angeles County Medical Society Building, Los Angeles (tentative announcement), Clarence W. Dail, M.D., Secretary, Loma Linda Sanitarium and Hospital, Loma Linda, Calif.

---

*New England Physical Therapy Society;* meetings at Hotel Kenmore, Boston on third Wednesdays from October to June; Dr. William McFee, 41 Bay State Road, Boston, Mass., Secretary.

---

*New York Physical Therapy Society;* meetings on first Wednesday from October to May; Dr. Madge C. L. McGuinness, 1211 Madison Avenue, New York, Secretary.

*Special Meetings;* Special Committee on Physical Therapy, New York County Medical Society. John D. Currence, M.D., Chairman.

---

*Pennsylvania Physical Therapy Association;* meetings at the Philadelphia County Medical Society Building, third Thursdays from September to June; Dr. Arno L. Zack, 216 East Broad Street, Bethlehem, Pa., Secretary.

---

*Pacific Physical Therapy Association;* meetings at Los Angeles County Medical Association Building, fourth Wednesday. Clarence W. Dail, M.D., Sec'y., Treas., Loma Linda, Calif.

---

*Kings County Medical Society, Physical Therapy Section;* meetings at 1313 Bedford Avenue, Brooklyn, bi-monthly on second Thursdays; Dr. H. T. Zankel, 5 St. Paul's Place, Brooklyn, Secretary.

## Dr. Cora Smith King Resumes Private Practice

It has come to our attention that Dr. Cora Smith King, who for over ten years was Director of the Physical Therapy Department of Hollywood Hospital has resumed private practice with major interest in physical therapy at 6006 Franklin Ave., Hollywood, Calif.

## Meeting Pacific Physical Therapy Association

The regular February meeting of the Pacific Physical Therapy Association was held February 23, 1938, in the Los Angeles County Medical Association Building, and the following porgram was presented: 1. Practical Aspects of Vitamine Therapy—A Review of the Latest Developments in Vitamine Research, *Henry Borsook,* M.D., Ph.D.; 2. Evaluation of Physical Therapy in Proctology, *Rex R. Frizzell,* M.D.; 3. Colonic Therapy in Chronic Colitis, *Cora Smith King,* M.D.

# THE STUDENT'S LIBRARY

DIE AKKLIMATISATION. By Dr. *Julius Grober*, Professor of Internal Medicine, Director of the Physical Therapeutic Institute of the University of Jena. Cloth. Pp. 156. Price, 6.50 M. Jena: Gustav Fischer, 1936.

The far traveled experiences of the author have recently included official study of solar radiation and climatic conditions in South Africa with a view of presenting information of value for colonization and acclimatization of the human under new geographic conditions. This is incorporated in this volume in a manner that favorably reflects the idealistic efforts of the scientist steeped in humanitarism tradition, and the physician turned explorer for the love of mankind. His theme is presented in five chapters and deals with the past and recent data about the complex factors of colonization and acclimatization of plants, animals and humans. The fourth and most important chapter discusses the means of acclimatization. Regarding the question whether a "pure" race or a mixture of races is more desirable for this purpose, Grober is emphatic that "even the most celebrated races" are mixed races and that the most renowned qualities of people are mainly due to this intermixture. The medical aspects of this provocative theme are discussed in detail. Grober's book therefore touches on an interesting multitude of problems related to hygiene, nature history, sociology, politics and philosophy. The absence of any subheadings or subtitles outside of the five main chapters makes its reading somewhat tedious but the contrasting advantage is that this avoids the dogmatic style of a text and allows for a free flow of thought. An English translation would widen the reading circle of this instructive and stimulating contribution.

---

DIATHERMIE ET DIATHERMOTHÉRAPIE À ONDES LONGUES ET MOYENNES. Par Le Dr. *H. Bordier*, Professor agrégé a la Faculté de Médecine de Lyon, Membre correspondant de l'Académie de Médecine, Lauréat de l'Institut, etc., etc. Preface by Bergonié. 7th Edition. Paper. Price 50 francs. Pg. 457 with 214 illustrations. Paris: J. B. Baillière, 1937.

With the background of having been a witness at the birth of high frequency current in medicine, and since then one of the foremost creative students to exploit this therapeutic method during the long interval between the negation, skepticism and affirmation of the physiologic and clinical effects of conventional and short wave diathermy, Bordier's opinions as presented in his seventh revised edition deserve the serious consideration and highest commendation given to a contribution containing the most advanced expression on the subject. Under the circumstances the reader is here assured of a text that reviews the progress of this discipline from its very incipiency through the experienced and critical mind of the outstanding exponent of high frequency practice in France. The book is divided into ten sections and these detailed into many chapters. The introductory chapter reviews in concise fashion the historic development of d'Arsonval's epochal labors together with the general properties of diathermy. Four of the initial sections are devoted to technical and laboratory considerations of high oscillatory currents and their physico-chemical effects on biologic material; the remaining six to the exposition of its practical evaluation in medicine and surgery. Of interest is the fact that Bordier was one of the earliest students of electrosurgery, this being especially appreciated on perusal of the 10 chapters devoted to its exposition. One learns that not only has the author introduced original opinions regarding technics and indications relatively unfamiliar to the average physician, but also instruments and electrodes that have facilitated the operative approach. Space will not permit more than a cursory mention of the analytic detail which embraces the discussion of the medical usefulness, limitations and dangers of modern diathermotherapy. This is dealt with in the chapters considering its applicability to certain muscular, arthritic, glandular and deep visceral affections. The author's long experience and critical attitude pervade throughout the pages and lends a conservative coloring frequently absent in newer works. It is therefore an authoritative and comprehensive text of value to student and practitioner,—indeed so authoritative as to be regarded among the first three world outstanding contributions on the subject. Its translation would render a great service to the English profession.

---

TECHNIK DER KNOCHENBRUCHBEHANDLUNG. Von Dr. Lorenz Böhler, Professor of Surgery at the University of Vienna. In two volumes. Vol. I. Cloth. Pp. 784, with 1,530 illustrations. Price, Rm. 30.00 Vienna: Wilhelm Maudrich Verlag (American Agency: Chicago Medical Book Co., Chicago), 1937.

One is impressed by two factors which tell more than lengthy descriptions. The first is that in spite of the precarious economic condition within nine years Böhler's monograph on the treatment of fractures by his method had to be republished as five separate and improved editions; the other factor is that very many American surgeons have familiarized themselves with the cast-to-skin technic because of the superior results obtained. What is admirable is that Böhler has crowned his life's work with a book of two volumes, the second of which will appear this spring. Even a superficial glance at the first 228 pages, which are devoted to injuries and fractures in general, suffices to show that the author has succeeded in placing the whole problem of injuries of this type and their treatment

on a sound scientific and technical basis. These, his doctrines, are shown in detailed application in fractures of the skull and vertebrae, ribs, sternum, pelvis, dislocations of the pelvic bones, fractures and dislocations of the clavicle, scapula and shoulder, all sorts of torsions and injuries of the shoulder and upper arm, dislocations and fractures of the elbow and wrist, until every phase and accident affecting the forearm and hand, including the individual fingers has been covered. Apart from the injuries mentioned, the author has carefully reviewed the problem of infected wounds and the management of stiffened joints especially of the hand and fingers. In other words, so far as the subjects covered in the first volume are concerned they have been treated in encyclopedic form, albeit with due consideration of the clinical needs. The illustrations, paper and print leave nothing to be desired. If the second volume will be on a par with the first one, the work will prove absolutely the most exhaustive exposition published either here or abroad.

---

PRACTICAL METHODS IN BIOCHEMISTRY. By *Frederick C. Koch*, Professor of Biochemistry, University of Chicago. Second Edition. Cloth. Pp. 302. Price, $2.25. Baltimore: William Wood & Company, 1937.

In the second edition of his Practical Methods in Biochemistry, Koch has enlarged the scope of his book by introducing specific instructions on urea clearance and on the quantitative estimation of albumin, globulin, sodium, and potassium in blood serum. This detailed improvement of an already excellent work will be welcomed by those who demand the most modern innovations in the field. In addition to supplying this demand Koch's work maintains its universal appeal by giving concise guidance that will receive the instant approval of the medical student for whom the book was planned. Though this text was originally introduced as a companion to A. P. Mathew's text on biochemistry, a function that it did quite admirably, succeeding years showed that its own intrinsic merits were such that it warranted its own place in the field, not as a supplement to one book, but as an able laboratory companion to any text that the student might choose. It is in this capacity that it is being used so successfully at the University of Chicago. As a manual for instruction to all the more important qualitative and quantitative chemical aspects of cell constituents, of cell activities and of the composition of blood secretions and excretions, this contribution should prove most efficient to students of the subject.

---

PHYSIOLOGICAL PRINCIPLES IN TREATMENT. By *Sir Walter Langdon-Brown*, M.A., M.D., Cantab., F.R.C.P., Consulting Physician to St. Bartholomew's, Emeritus Professor of Physics and Fellow of Corpus Christi College in the University of Cambridge; and *Reginald Hilton*, M.A., M.D., Cantab., F.R.C.P., Physician in Charge of Out-Patients, St. Thomas Hospital, etc. Seventh Edition. Cloth. Pp. 308. Price, $3.00. Baltimore: William Wood & Company, 1936.

It is generally agreed that when a scientific contribution passes beyond its third edition, its continued demand must rest on factors so basically sound, necessary and desirable as to be considered of cardinal importance. The fact that this work has passed through seven editions suggests that demand has given it the stamp of approval because of the informative material it incorporates and the lucid manner in which it is presented. The rapid and important progress in medicine together with its changing opinion is reflected in the thirteen chapters of this book. The inter-related and independent action of hormones and vitamins is reviewed from its physiologic and clinical aspects. The action of the pancreas is clarified, the fallacy of past opinions on intestinal toxemia is pointed out, the uric acid bugbear is reduced to a workable equation, and the role of calcium in the body is correlated with vitamin D and parathormone in a logical fashion — all this by conservative evidence acceptable to critical students and clinicians. Certain changes and revisions in the text are noted. For instance the present work has incorporated the subject of ketosis in the chapter of diabetes where it logically belongs as a part of the subject of carbohydrate metabolism. Allergic manifestations have been included as an extension of the chapter on asthma. The data so well support the authors' justification for this broad classification as a part of the scientific doctrine of diathesis that argument against idiosyncrasy and for mechanical interference falls of its own weight in the face of the evidence presented. The attraction of this work undoubtedly is its lucid and vigorous style, virtues that are the condiments of intellectual contributions in science as in the arts.

# INTERNATIONAL ABSTRACTS

### Short Wave Therapy in Articular Diseases. V. Maragliano.

Wien. med. Wchnschr. **87**:756 (July 10) 1037.

Maragliano employed short wave therapy in about 100 cases of articular disorders. The short waves were employed to obtain a thermic effect. The treatment was nearly always local. In applying the rays to the large joints, the body temperature was usually slightly raised. It was observed that the best results could be obtained when the patients were kept resting after the treatment. Accordingly, the treatment was most effective with hospital patients. In some instances acute exacerbations were observed after the first few treatments, but these subsided again and it appeared as if the incipient exacerbation indicated a favorable final result. The response to short wave treatment was most favorable in the traumatic articular processes, such as the sequels of distortions, of luxations and of endo-articular or periarticular fractures. In the articular disorders of metabolic origin, such as gout, short wave therapy produced varying results; for whereas some cases responded favorably, others were not improved or were even exacerbated. In the metabolic articular disorders as well as in the chronic polyarthritides it may be advisable to combine the local treatment with general treatment, the aim of the latter being a slight increase in the body temperature. Short wave treatment of arthritis deformans produced only a temporary reduction in pain. An analgesic effect was produced also in the gonorrheal arthritides. The author treated only one case of tuberculous arthritis with short waves and in this case the treatment failed. The combination of short wave and roentgen therapy proved helpful in counteracting the pains in arthritis deformans. — [Abst. J. A. M. A. 109:833 (Sept. 4) 1937.]

---

### Cause of Complications After Short Wave Treatment. P. Liebesny.

Med. Klin. **33**:830 (June 18) 1937.

Liebesny points out that he and his collaborators observed in 1931 and 1932 that, when short waves were used which produced considerable thermic effects, vascular damage was likely to result. It was observed also that the use of longer waves results in more severe vascular changes than does the use of shorter waves, for the reason that the longer waves produce greater thermic effects. In this paper the author tries to determine whether complications that appear after short wave therapy can be brought in causal connection with these rays when an excessive dosage can be definitely excluded. He shows that in two cases of his own observation and in three cases from the literature an excessive dosage with harmful thermic effects is out of the question and that therefore a causal connection between the short waves and the symptoms mentioned cannot be assumed. He admits that, if harmful effects develop in rare cases after the use of small doses, it might be suggested that in some persons the tissues have a hypersensitivity to short waves. In order to solve this question, further investigations will be necessary, for observations thus far do not justify such an assumption. Moreover, the author suggests that the complications may be due to the peculiarity and the localization of the condition treated; that is, they develop in spite of the short wave therapy rather than because of it. — [Abst. J. A. M. A. **109**:630 (Aug. 21) 1937.]

---

### Exercise and Rest in Pulmonary Tuberculosis. Voûte.

Schweiz. med. Wchnschr. **67**:921 (Sept. 25) 1937.

Voûte directs attention to the fact that, as the result of the prolonged inactivity and rest cure of the patient's with pulmonary tuberculosis, their respiratory and circulatory organs become weakened. Training to counteract this weakened condition should be instituted under the guidance of a physician as soon as possible. The author accomplished this aim by beginning work therapy early and, in suitable cases, by means of light individual gymnastics combined with massage. When the work therapy is begun, the rest periods should be gradually reduced so that, when the patient is discharged from the sanatorium, he requires at the most two hours of rest daily. — [Abst. J. A. M. A. **109**:1675 (Nov. 13) 1937.]

---

### Vitamin C and Oil of Bergamot for Protection Against Ultraviolet Rays. E. Urbach and F. Kral.

Klin. Wchnschr. **16**:960 (July 3) 1937.

Urbach and Kral describe experiments which prove that the oral, rectal or parenteral administration of vitamin C in combination with the external application of oil of bergamot has a definite photoprotective effect. However, in order to protect the skin against ultraviolet rays, it is necessary that vitamin C form a chemical compound with the entire complex of oil of bergamot. Vitamin C acts most rapidly after intravenous administration, for if so administered it becomes effective after one hour, as against three hours in oral administration. This indicates that not the vitamin as such but rather one of its products protects against light rays. Moreover, if vitamin is rubbed into the skin, it does not prevent the ray erythema. It is noteworthy that only natural but not rectified oil of bergamot protects against

light. Even heating to more than 60 C. cancels the effectiveness of the oil against ray erythema and none of its constituents exert the photoprotective action. Moreover, the combination of vitamin C and oil of bergamot protects only against short, not against long, light waves. — [Abst. J. A. M. A. **109**:833 (Sept. 4) 1937.]

**Pigmented Basal-Cell Epithelioma. J. Gaté, G. Massia and J. Delbos.**

Ann. de dermat. et syph. 8:337 (May) 1937.

Gaté and his associates describe a variety of basal-cell epitheliomas with a histologic picture characterized by an abnormal quantity of pigment granules. Any intervention for biotic specimens may stimulate the neoplastic process. It is therefore prudent to suspect every pigmented neoplasm of being malignant and to make a biopsy only after physical therapy has been instituted. For the same reason any surgical intervention is regarded as dangerous. The authors are in favor of roentgen therapy, for which they use from 3,500 to 4,000 roentgens without filter, a spark gap of 18 cm., 4 milliampere current and a focus-skin distance of 22 cm. To secure a thorough irradiation it is well to use fields extending from 2 to 5 mm. beyond the borderlines of the neoplasm. After about a week the tumor begins to ulcerate. At this stage no curet or scissors may be used. It is enough to use warm physiologic solution of sodium chloride applied with a syringe. The wound is then covered with an ointment of bismuth subnitrate and zinc oxide and dressed. Some authors prefer diathermocoagulation, perhaps because of its greater cosmetic value. But it is a painful procedure and it must be preceded by a locoregional or local anesthesia. Care must be taken to inject any healthy tissue with the anesthetic. The first treatment consists in forming a barrier by a series of small coagulations against dissemination. The second treatment consists of coagulating layer after layer, the layers being shaved off until healthy tissue is reached. The dressing may be dry or slightly greased. Cicatrization takes about three weeks. — [Abst. J. A. M. A. **109**: 469 (Aug. 7) 1937.]

**Diathermy in Arterial Hypertension. G. Garlero Pizarro and P. Levisman.**

Prensa med. argent. **24**:1625 (Aug. 18) 1937.

Gorlero Pizarro and Levisman resorted to diathermy of the carotid sinus in the treatment of arterial hypertension. Patients who improved by rest were excluded. Diathermy was administered by means of an apparatus which consisted of two common electrodes 8 cm. long and 2.5 cm. wide (positive poles) and a common diathermy square plate of 12 cm. (negative pole). The electrodes were placed at the carotid region, whereas the plate was placed at the pectoral region. The diathermic applications were given every other day to patients with a fasting stomach. The first application lasted ten minutes. The duration of the following applications was increased by five minutes for each application up to a duration of thirty minutes. The treatment consisted of six or seven sittings. The group was made up of forty patients. Thirty patients suffered from essential hypertension. The other ten had arterial hypertension from nephrosclerosis. The thirty patients suffering from essential hypertension were relieved from headache and dizziness and became euphoric. The blood pressure, maximal and minimal, was lowered 2, 3 or 4 cm. in twenty patients of the group and hypertension did not change in ten patients. In the group of ten patients who were suffering from hypertension and nephroscleroses the treatment modified neither the symptoms nor the blood pressure. The treatment is harmless. According to the authors, the factors that induce lowering of essential hypertension are sympathetic reflexes and dilatation of the arteries and veins induced by diathermy of the carotid sinus. — [Abst. J. A. M. A. **109**:1161 (Oct. 2) 1937.]

**The Mechanical Resuscitation of the New-Born. A Report of 500 Cases. D. Ben Martinez.**

J. A. M. A. **109**:489 (Aug. 14) 1937.

Martinez reports his studies of positive and negative pressure on 500 cases of new-born infants requiring mechanical resuscitation. This information made into a chart was submitted and approved by the American Medical Association. The author believes that this mechanical positive and negative pressure apparatus is a definite improvement over any other method, not only in resuscitating the babies that actually need it but also in aiding the babies that just do not cry vigorously. The safety of this apparatus is certainly an important factor, since any one (nurse or intern) with a little training can use it, thereby permitting the obstetrician to devote his full attention to the mother, when needed, as is very often the case in difficult deliveries, in which asphyxia is apt to occur. The resuscitator is almost fool proof, as the positive and negative pressure ceases automatically when the child breathes of its own accord and allows it to breathe the oxygen from the bag, or, if desired, it may breathe the oxygencarbon dioxide mixture through the inhalator attachment. The apparatus is definitely life-saving and should be a part of the armamentarium of all hospitals that have obstetric patients.

**Value of Fever Therapy in Arthritides. E. E. Simmons.**

Am. J. M. Sc. **194**:170 (August) 1937.

Simmons points out that, of nine cases of acute rheumatic fever with active endocarditis, six became inactive in an average of twenty-four days, following an average of five fever treatments. Three cases of acute rheumatic fever with active endocarditis and complicated by chorea became inactive in an average of forty-six days, following an average of nine fever treatments. This is a marked improvement over any other type

of therapy and justifies further investigation. Of twenty-three cases of gonococcal arthritis, 82 per cent were cured or markedly improved after an average of 26.4 hours of fever maintained between 106 and 107 degrees F. A minimum of at least twenty-five hours of fever at this elevation is necessary before this therapy is concluded to be a failure. Artificial fever therapy is a valuable adjuvant, along with dietary, supportive and orthopedic measures, in the treatment of atrophic arthritis. This combination of treatment was of benefit in 78 per cent of the thirty-six patients treated. Hypertrophic arthritis is benefited by artificial fever therapy only in those cases in which there is a superimposed traumatic and infectious element. In any type of arthritis, with or without an infectious element, heat is a justifiable therapeutic measure. Other means of producing febrile reactions are not so efficiently controlled nor so safe as mechanically induced fever therapy. The beneficial effects of fever therapy in the arthritides, with the possible exception of gonococcal arthritis, are in all probability not solely bactericidal but rather the result of the beneficial effects of vasodilatation and increased immunologic response. — [Abst. J. A. M. A. **109**: 904 (Sept. 11) 1937.]

---

**X-Ray Therapy of Unresolved Pneumonia Which Becomes Chronic. (Die Röntgentherapie der chronisch verlaufenden Lungenentzündung.) Joseph v. Palugyay.**

Wien. klin. Wchnschr. **50**:944 (June 18) 1937.

Controlling 17 cases the author found that it is possible favorably to influence the course of chronic pneumonia by x-rays even in cases with abscess formation while pneumonia with extensive pleural destruction and bronchiectasis were not improved. In some of the cases the improvement occurs promptly, as shown by the rapid disappearance of pain, typical change of the temperature, either by lytic or sharp critical decrease or of the "picket fence" type immediately after application of the rays. The symptoms, infiltrations and even abscesses disappear in a short time. This effect is produced by relatively small doses. Partial irradiations are to be used, 10-30r, no more than 1/10 skin- erythema- doses.

---

**Rickets Resistant to Vitamin D Therapy. Fuller Albright, Allan M. Butler, and Esther Bloomberg.**

Am. J. Dis. Child. **54**:529 (Sept.) 1937.

This report deals with a boy of 16 who had suffered from rickets since the age of 1 year in spite of treatment with vitamin D. Histologic evidence demonstrated that the condition was true rickets and not some other condition resembling rickets is presented. Metabolic data are present to show that the changes in the calcium and phosphorus metabolism were similar to those in ordinary infantile rickets. Evidence is presented to show that the cause of the disorder was not a primary hyperparathyroidism, though a secondary hyperparathyroidism was present and was probably the cause of the hypophosphotemia. The resistance to vitamin D therapy was not due to failure to absorb vitamin D, since crystalline vitamin D injected intravenously and radiation from an ultraviolet ray lamp were ineffective. With massive doses of vitamin D, such as from 150,000 to 1,500,000 U. S. P. units daily by mouth (from 15 to 150 cc. of viosterol or from 15 to 30 cc. of crystalline vitamin D in propylene glycol), the disorder of metabolism was corrected and healing of the rickets took place. Evidence is presented which suggests the necessity of observing the patient carefully lest, with the healing of the rickets, too large doses of vitamin D produce hypervitaminosis. Attention is called to the fact that the disturbance in this patient cannot be considered a deficiency disease like ordinary rickets. It is rather a form of rickets due to an intrinsic resistance to the antirachitic action of vitamin D. This resistance, however, can be broken down with massive doses.

---

**Behavior of Small Cavities of Lungs After Treatment With Light. A. C. Hissink.**

Strahlentherapie **60**:427, 1937.

By systematic illumination of the body, starting with irradiation of the legs and slowly proceeding to the whole body by carbon arc lamps—in summertime with sunlight—the author succeeded in getting spontaneous healing of small cavities of the lungs in 3 cases. By administration of vitamin B, C and D and of calcium and phosphorus the increase in weight was augmented and secured.

---

**Specific Physiological Action of Ultra-High Frequency Field. W. M. Archangelski.**

Wein. med. Wchnschr. **28**:746 (July) 1937.

The author and many others, as Schliephake, Liebesny, and Weissenberg believe in a specific physiologic action of the ultra-high frequency field, but its determination is not possible until the heat production is excluded. First experiments with a transmitter of low intensity (100 watts) were in 1934. By decreasing the thermic action of the ultra-high frequency field the author found that it was not the amount of absorbed energy which played the main part, but the electric shock. A few observations serve as evidence of the specific physiologic action of the ultra-high frequency field:

1. Botanists (Kuperman) observed an acceleration of the growth and better development of cotton seeds, afer irradiation.

2. Pflomm demonstrated a dilatation of the capillaries after irradiation with the ultra-high frequency field. The dilatation persisted for two weeks and did not contract after administration of epinephrin.

3. The nerve muscle specimen while in the ultra-high frequency field responded with tetanic contractions when stimulated with sodium chloride.

4. Under the influence of an electric field the contractions of the isolated heart became accelerated. The fluid which passed through the heart during irradiation acquired the ability to accelerate the action of another heart, but only when the action of the irradiated heart was accelerated. The amplitude of the contraction was usually diminished under the influence of the ultra-high frequency field. Similar results were obtained by radiating a heart in *situ* provided that the innervation remained intact.

G. Davidsohn.

---

**Infra-Red Rays. A. P. Cawadias.**

British J. Phys. Med. **12**:93 (Sept.) 1937.

The first point in the technic of applying infra-red rays is choice of apparatus. There are two groups of infra-red generators used in medicine; the first group emits the infra-red rays necessary in medicine, that is rays ranging up to 50,000 Angström units, together with luminous rays; the second group comprises generators producing only infra-red rays, termed dark body apparatus. There is no special advantage in the latter group. At present the prime factors in infra-red technic are intensity and facility in increasing and diminishing that intensity. Thus for the practical necessities of every day the general practitioner needs a powerful lamp generating luminous as well as infra-red rays. These rays may penetrate as deep as one inch or less, depending on the luminosity and intensity of the radiation. The heat generated in the rays penetrates, some as much as one inch into the body; others, the long infra-red rays, penetrate less profoundly and are absorbed sooner. Heat is a form of energy capable of transformation into many physiologic responses, which explains the most important effects of infra-red irradiation. The dosage may be varied from a suberythematous effect, which is mildly sedative; to an erythematous dose, which is vasodilating; to a sudative dose, which is more intense and produces greater changes in the tissues.

---

**Action of Short Waves (15 m, 3.5 m, and 52 cm.) Upon Diphtheria Bacilli. E. Hasche, with cooperation of H. Leuning, and P. Lock.**

Deutsche med. Wchnschr. **49**:1835 (Dec.) 1937.

The authors investigated the influence of short waves upon the growth of diphtheria bacilli to the wavelength and to medium in which the bacteria were suspended. Waves 52 cm. long did not influence bacilli suspended in distilled water. Waves 3.5 m. long killed the bacteria in few cases, but the reason could not be detected. Irradiations of bacterial culture in cystine-blood agar, with 3.5 m. and 15 m. wavelength showed that heat is the only factor which influences the bacteria. The experiments showed a very high degree of resistance to heat of the diphtheria bacilli. External factors, for instance, the liquid in which the bacteria are suspended or the culture media seem to be of greater importance, than the irradiations. Irradiation could be of importance only if the living conditions of the bacteria were exceptionally unfavorable, for example in chronic inflammations. In those cases irradiations with short waves may disturb the equilibrium and influence the bacteria unfavorably. The author emphasizes that his results do not indicate any specific biological action of short waves upon bacteria as described by other writers.

G. Davidsohn.

---

**Neuropsychiatric Effects of Electric Trauma. Paul A. Draper.**

Colorado Med. **34**:650 (Sept.) 1937.

Concerning the neurological effects of lightning and electricity, three types of injury occur. First, immediate, including shock, unconsciousness, and suspended animation. Second, secondary, including visual disturbances and temporary nervous disorder. Third, remote effects comprising rare neurological and ocular complications. In general, neurologic signs after electric and lightning accidents are comparatively infrequent.

---

**Tidal Irrigation of the Colon to Reduce Hyperthermia: A Preliminary Report. E. J. Steenrod.**

Proc. Staff Meeting, Mayo Clinic **12**:618 (Sept. 29) 1937.

Tidal irrigation of the colon when used alone is capable of lowering the bodily temperature several degrees, but is more effective when combined with cold sponge baths of the entire body and application of ice bags to the axillary and femoral regions. This procedure replaces the colonic flushings which heretofore have been given intermittently, by the adoption of a metal container and rubber tube through which the cold water flows into the bowel by gravity and in most cases must be siphoned back. Colonic flushing, as practiced in the past, although effective in lowering bodily temperature is cumbersome, uncomfortable and tiresome for both the patient and attendant. The apparatus may be run for several hours at a time. In conjunction with other means of lowering body temperature such as application of ice caps and cold sponge baths it usually requires four to five hours to lower the body temperature 3 to 4 degrees F. At this time the tube should be withdrawn and it can be reinserted later if necessary. An attempt to use the Elliott apparatus or a rubber bag on the end of a rectal tube attached to the apparatus has not proved as effective as the plain rectal tube which allows the cold water to circulate through the lower part of the intestine, to drain off, and to be replaced by more cold water at each cycle.